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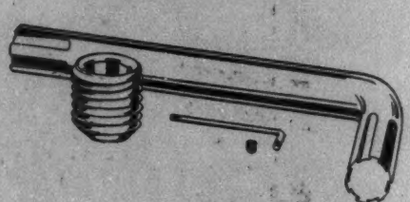

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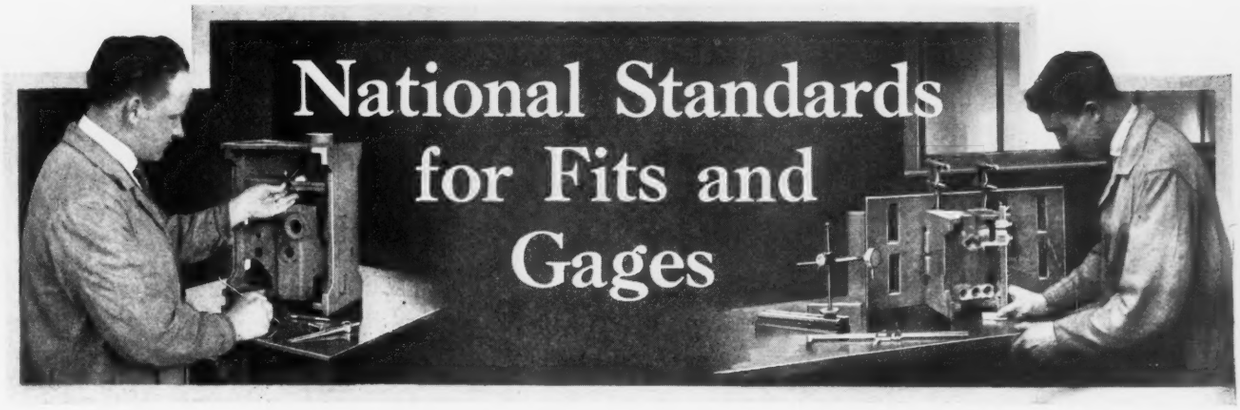

National Standards for Fits and Gages

Comparison of the Standards Established in the United States, Great Britain, Holland, Sweden, Germany, Austria, and Switzerland

By JOHN GAILLARD*, Mechanical Engineer, American Engineering Standards Committee, New York City

THE American Engineering Standards Committee (A.E.S.C.) has approved a tentative American standard for tolerances and allowances for metal fits, established by a sectional committee appointed under procedure of the American Engineering Standards Committee, and sponsored by the American Society of Mechanical Engineers. The following is a brief review of this standard and of the national standards on the same subject that have so far been established in foreign countries. (An additional tentative standard for methods of gaging and specifications for plain limit gages is in course of preparation by the same sectional committee, but has not reached its definitive form at the present time. It deals with the classification of gages according to type, design, dimensions, and tolerances.)

John Gaillard

In order to facilitate a comparison between the national systems, diagrams are given in each case for different kinds of fits between two mating parts with a nominal diameter of one inch. Thus, the diagrams Figs. 1 to 4 make it possible to readily compare the standards for Great Britain, Holland, the United States, and Sweden, and Figs. 8 and 9 show the standards for Germany and Switzerland, respectively. The tolerances for the holes are represented in the diagrams by cross-sectioned bars above the reference line (this line indicating the nominal size), while the tolerances for the shafts are represented by bars in solid black. The allowance is represented by the space between the solid bar and the top of the reference line.

These tolerances and allowances are, of course, greatly magnified, but all diagrams are to the same scale so that a direct comparison may be made. The allowances and tolerances on the various diagrams are expressed by figures representing ten-thousandths of an inch. For example, the allowance and tolerance designated by the letter M in Fig. 1 are each equal to 0.0006 inch, as indicated by the figures 6 and 12 which represent the number of ten-thousandths inch from the reference line. It will be noted that these figures representing units of one ten-thousandth inch, have been placed on all diagrams, including those for the metric countries where the original standards are expressed in microns (1 micron = 0.001 millimeter, or about 0.00004 inch); hence the diagrams serve for direct comparison.

In cases where the national standard comprises both the basic hole and the basic shaft systems, only the former is represented in the diagram. For Great Britain, whose standard comprises both the unilateral and the bilateral systems, only the unilateral system, recommended by the standard as preferable, is shown.

Tentative American Standard

It may be well to discuss first the most important terms used in connection with problems of fit. A valuable feature of the American standard is that it begins by giving definitions of the terminology. Diversity in the use of terms is still causing much confusion in the discussion of problems in this field.

The "allowance" is the minimum clearance or the maximum interference between two mating parts. It is the difference in size between the minimum hole and the maximum shaft, which difference is positive for a loose fit, and negative for a tight fit.

The "tolerance" is the amount of variation permitted in the actual size of a part, a certain degree of inaccuracy in manufacture being unavoidable. It is the difference between the high and the low limits specified for a given size and is measured from a basic size, either in one direction (unilateral system) or in two directions (bilateral system). It is general practice to adopt the nominal size of the mating parts as the basic size for one of these. Thus, in the unilateral "basic hole" system, the nominal size is the low limit for all holes (independent of their tolerances), while the different allowances are obtained by varying the high limit of the shaft. In the unilateral "basic shaft" system, the nominal size is the high limit for all shafts (independent of their tolerance), the different allowances being obtained by varying the low limit of the hole. Fig. 5 shows, by two diagrams, the allowance and the tolerances on the mating parts, for a loose and a tight fit. These diagrams also ex-

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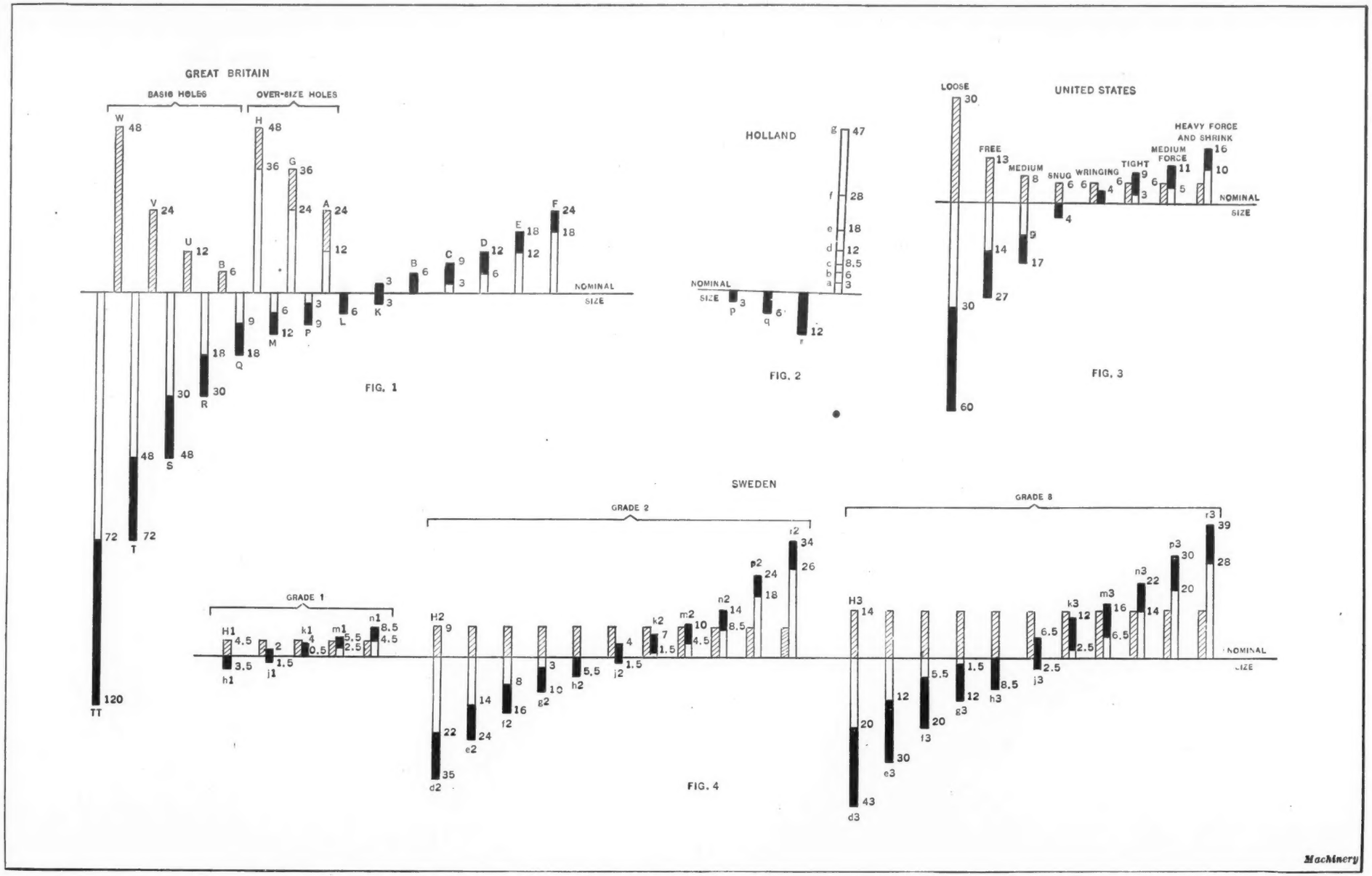


Figs. 1, 2, 3, and 4. Diagrams arranged to facilitate Comparison between Different National Standards. Various Classes of Fits for Mating Parts are represented, each having Tolerances and Allowances for a Nominal Diameter of 1 Inch

plain the method of representation of allowances and tolerances in the diagrams for the other national systems which will be referred to later.

In the American system (Fig. 3) the unilateral basic hole system has been adopted exclusively. Eight different classes of fits are explicitly mentioned. They are numbered and also designated by names, as follows: (1) loose; (2) free; (3) medium; (4) snug; (5) wringing; (6) tight; (7) medium force; (8) heavy force and shrink fit. Each class is characterized by the combination of a definite allowance and definite tolerances on the mating parts, for a certain range of nominal sizes. However, the designer should not feel confined to the exclusive use of these eight specified combinations. If desired, he may also use a hole belonging to one class of fit (say "free fit") in combination with a shaft belonging to another class (say "medium fit"). Such special combinations outside the eight classes of specified fits, may be useful in cases where it is desirable to maintain the allowance given for a certain standard class of fit, and yet desirable to change the permissible maximum clearance or minimum interference by deviating from the tolerance on the hole specified for that particular class of fit.

For example, the designer may want to adopt, for two parts with a nominal diameter of 1 inch, the minimum clearance of 0.0014 inch as specified for a free fit (Fig. 3). If now the maximum permissible clearance of 0.0040 inch of the free fit is considered too large for his special purpose, the combination of the "free fit" shaft with the "medium fit" hole may be chosen, which gives the same minimum clearance of 0.0014 inch, but a maximum clearance of only 0.0035 inch.

The fits of classes 1 to 4 are considered to give perfect interchangeability between holes and shafts. Those according to classes 5 to 8, on the contrary, may require "selective assembly," that is, the mating of a shaft which is on the large side with a hole which is also on the large side, and conversely. The tables for the fits in classes 5 to 8 not only have columns for the loosest and tightest fit, but also for the "selected" fit, that is, the fit with the "average interference."

Applications of Different Classes of Fits

The following recommendations are given in the standard for the application of the different classes of fits:

The *loose* fit (class 1) is to be used in certain cases where accuracy is not essential. Examples: Machined parts of agricultural and mining machinery, controlling apparatus for marine work; textile, rubber, candy, and bread machinery; general machinery of a similar grade; some ordnance material.

The *free* fit (class 2) is meant for running fits for speeds of 600 R.P.M. or over, and journal pressures of 600 pounds per square inch or over. Examples: Dynamos, engines, many machine tool parts, and some automotive parts.

The *medium* fit (class 3) is recommended for running fits for speeds below 600 R.P.M., and with journal pressures less than 600 pounds per square inch; also for sliding fits and the more accurate machine tool and automotive parts.

The *snug* fit (class 4), whose allowance is zero, provides a "metal-to-metal contact" between the maximum shaft and the minimum hole. Fits of this class are the closest that can be assembled by hand, and necessitate work of considerable precision. They are recommended for cases where no perceptible shake is permissible and where moving parts are not intended to move freely under a load.

The *wringing* fit (class 5) has a very small negative allowance, and will practically give a metal-to-metal contact. This fit is also known as a "tunking" fit.

The *tight* fit (class 6) has a small negative allowance, and requires a light pressure for the assembly of the mating parts. This fit is used for parts that are more or less permanently assembled, such as the fixed ends of studs for gears, pulleys, rocker arms, etc. It is also used for drive fits in thin sections, for extremely long fits in other sections, and for shrink fits in very light sections. It is applied in automotive, ordnance, and general machine manufacturing.

The *medium force* fit (class 7), with a negative allowance, requires considerable pressure for assembling, and is used for parts that are to remain permanently assembled, as, for example, locomotive and car wheels and their axles, armatures and shafts of dynamos and motors, and crank disks and their shafts. Medium force fits are also used for shrink fits in medium sections, or for long fits. These fits are the tightest recommended for external members of cast iron, as they stress this material to its elastic limit.

The *heavy force and shrink* fit (class 8) has a considerable negative allowance, and is used for steel external members, as these can be highly stressed without exceeding the elastic limit of the material. This fit would cause excessive stress for holes in cast iron. Shrink fits are used where heavy force fits are impractical, as in assembling locomotive wheels and their tires, heavy crank disks of large engines, etc.

Tolerance Specifications—Reference Temperature

The tolerances on holes apply only to reamed holes or holes having a finish equivalent to reaming. The American standard states explicitly that the manufacturing tolerances on gages and their permissible wear shall always be specified so as to keep the product within its limits. For example, an external "Go" gage (say a snap gage) will generally wear larger and thereby increase the high limit for the shaft. If, therefore, this limit is 0.0014 inch below the nominal size (see the "free fit" shaft in Fig. 3), the low limit for a new "Go" gage of this kind should be slightly more under-size, for example 0.0016 inch. The "Go" gage will then be allowed to wear out 0.0002 inch before being rejected.

The opposite applies to an internal gage, for example, a plug gage. This will wear smaller and thereby reduce the low limit for the hole. The high limit of a new internal "Go" gage must therefore be chosen slightly above the low limit for the hole. The limits between which the actual size of "Go" and "Not Go" gages should lie will be given in a further tentative American standard which has not yet been completed.

The standard reference temperature for American limit gages is 20 degrees C., or 68 degrees F. This means that the gages must have their nominal sizes at this temperature. The "nominal size" of a gage is the same as the limit of the product that the gage is supposed to check. For example, the nominal size of a "Go" snap gage for a 1-inch "medium fit" shaft (see Fig. 3) is 0.9991 inch, and the nominal size of the "Not Go" gage 0.9983 inch.

Standard in Great Britain

The British standard of 1924 for "limits and fits for engineering" (a revision of the standard of 1906) gives a unilateral and a bilateral system of tolerances. However, the standard explicitly recommends that the unilateral system be used where it does not conflict with predominating practice. This recommendation applies, therefore, in all new cases where a tolerance system has to be introduced.

The standard gives the following data: (1) Four basic holes with different unilateral tolerances; (2) four basic holes with different bilateral tolerances; (3) fourteen shafts with different allowances and tolerances, to be used either with unilateral or bilateral holes; (4) three "over-size" holes, common to the unilateral and the bilateral systems; (5) extra large bilateral tolerances for non-mating holes and shafts or holes and shafts that are not meant to give a definite kind of fit.

The first four groups of data are represented in Fig. 1. Group 5 will be left out of consideration here, as it does not apply to fits. The unilateral tolerances on holes are the same as the bilateral. They progress in the ratio 1:2:4:8. All bilateral tolerances are symmetrical, that is, equally divided on both sides of the basic size. The "over-size" holes, whose tolerance equals that of the basic hole "U" constitute, in reality, a departure from the basic hole system. They are meant, as the standard states, "to meet exceptional conditions." An over-size hole may be applied, for example, for obtaining a running fit with a shaft which gives tight fits with a number of other (basic) holes. If no over-size hole were available, such a shaft would have to be reduced locally in diameter in order to provide for this running fit.

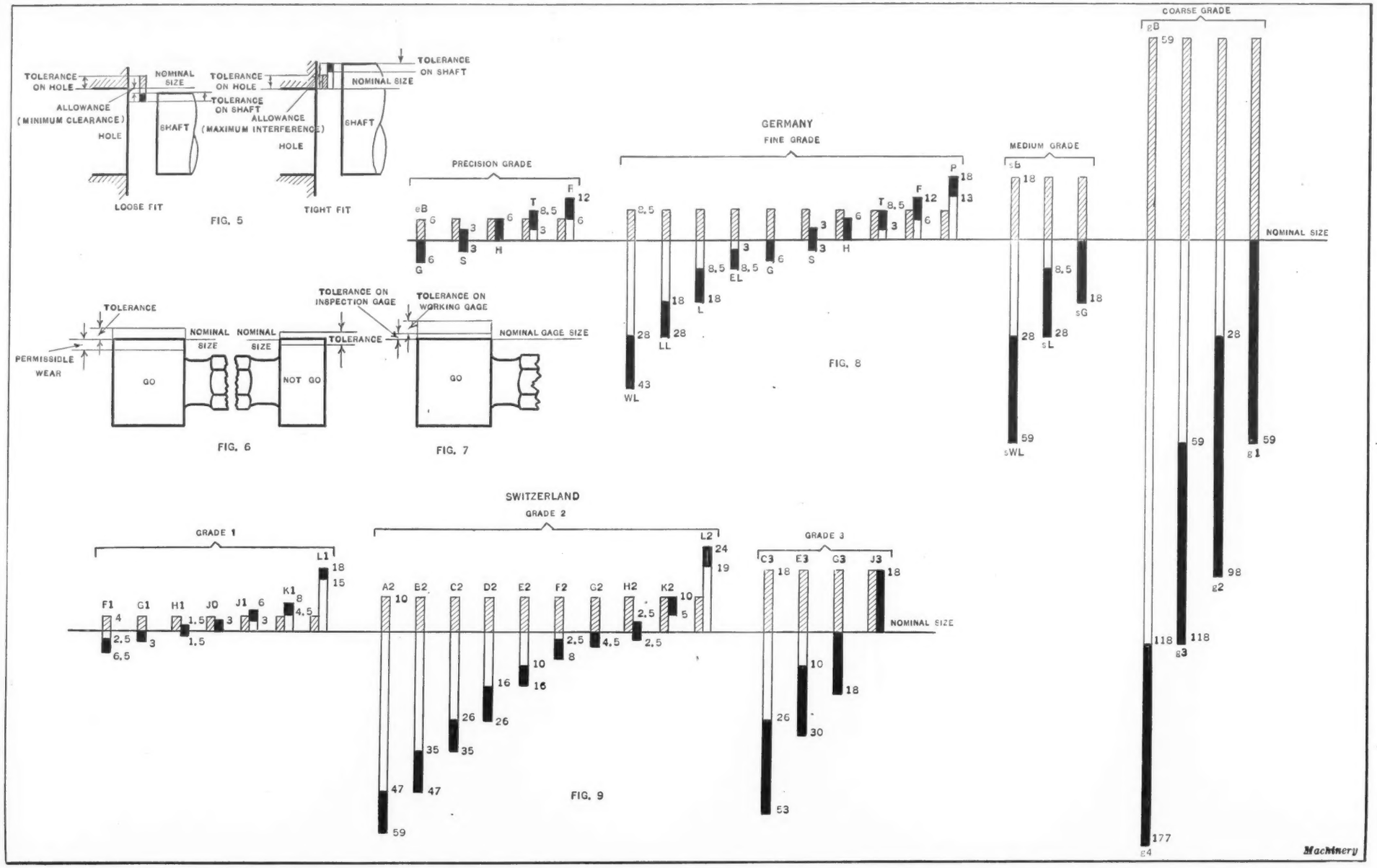


Fig. 5. Diagram showing Method of representing Allowances and Tolerances. Figs. 6 and 7. Methods of applying Gage Tolerances. Figs. 8 and 9. Diagrams representing Standards in Germany and Switzerland

The fourteen standard shafts each represent a different combination of an allowance and a tolerance. In order to provide for different classes of fits between a shaft and a basic hole, all of the fourteen allowances are different from each other. There are altogether six different tolerances on shafts, which progress in the ratio 1:1.5:2:3:4:6. The smallest tolerance on shafts is the same as the smallest one on basic holes.

The British standard distinguishes between "clearance," "interference," and "transition" fits. When a positive or a zero clearance obtains even between the largest shaft and the smallest hole "tolerated" (the hole never being smaller than the shaft), the fit is a "clearance fit." When a positive or a zero interference obtains even between the largest hole and the smallest shaft tolerated (the shaft never being smaller than the hole), the fit is an "interference fit." And when the limits specified for the mating parts admit of either clearance, interference, or zero allowance, the fit, being evidently an intermediate one between a clearance and an interference fit, is called a "transition fit."

No specific combinations of a hole and a shaft are designated in the British system as standard "classes" of fit. This means that the designer is free to mate, from the standard series, whatever hole and shaft he wants. Holes and shafts are designated by letters; a fit may therefore be indicated on a drawing by the combination of the corresponding letters for the mating parts, for example: "UR."

The manufacturing tolerances on "work-shop" gages, and their permissible wear must be specified in such a way as to keep the product within its own limits, according to the British standard. However, the tolerances on "inspection" gages must be taken outside the limits of the product, so as to be sure that no work whose size lies inside the limits will be rejected. Therefore, under the regulations of the British standard, work that exceeds the specified limits slightly (theoretically, by an amount equaling the tolerance on the gage) may be accepted by the inspector. No figures are given in the British standard for tolerances on gages, or their permissible wear.

Standard in Holland

Up to the present time, Holland is the only country that has adopted exclusively the unilateral basic shaft system. No allowances or tolerances on holes and shafts are specified, but only a series of seven limits above nominal size, and a series of three limits below the nominal size (see Fig. 2). Including the nominal size, there are thus eleven standard limits. The only restriction of the designer's choice is that the high limit for the shaft must be the nominal size; this is inherent in the basic shaft system. As to the low limit of the shaft and both limits for the hole, he may choose between ten limits to best suit the requirements of a fit.

The standard limits are designated by letters, those for the shafts by p, q and r, and those for the holes by a to g, inclusive. A fit is indicated on a drawing by a fraction, which has for its numerator the two letters for the limits of the hole, and for its denominator the letter for the low limit of the shaft (its high limit, nominal size, is omitted as understood). Example: $\frac{a.b}{p}$.

The Dutch system insures great flexibility in the choice of a standard fit. In the case of a running fit, for example, the designer may first select the low limit of the hole so as to secure the desired allowance between the hole and the basic shaft. In selecting thereafter the high limit for the hole and the low limit for the shaft, he has only to take care that the maximum permissible clearance is not exceeded. He has a certain freedom, however, in distributing the sum of the tolerances on the mating parts in such a way between the two parts as best suits existing conditions (materials of the mating parts, process by which these are machined, etc.)

The reference temperature for gages in Holland is 20 degrees C. Distinction is made in the standard between working and inspection gages. The low and high limits of a new internal working "Go" gage (for example, a plug gage) lie 5 and 20 per cent of the tolerance on the product, respectively, above the nominal size of the gage (see Fig. 7). For external gages (snap gages, etc.) these conditions are reversed. The tolerance on working "Go" gages is, therefore, 15 per cent, and the tolerance on inspection "Go" gages, 5 per cent of the tolerance on the product. Working "Go" gages that are worn to the point where they must be rejected, may be used as inspection "Go" gages until they are further worn to nominal gage size. In the Dutch, just as in the American system, no accepted shaft can be larger than its specified high limit, nor an accepted hole smaller than its low limit. No limits for "Not Go" gages are specified in the Dutch standard.

Standard in Sweden

The Swedes have adopted exclusively the unilateral system. Their standard provides for both the basic hole and the basic shaft system. The former is represented in Fig. 4. There are three grades of fit, which are indicated by numbers, grade 1 being the highest. The ratio between the tolerances on the basic holes of the three grades is 1:2:3. Altogether, there are twenty-seven completely defined fits.

The different classes of fits are designated by names or by a combination of the symbols for the hole and the mating shaft, the hole being mentioned first. The holes are designated by capitals, the shafts by lower case letters, and each letter is followed by the numeral 1, 2, or 3, in accordance with the grade of fit. Thus, for example, a "free" fit (to use the American standard term) of the second grade would be indicated by H2-e2 (see Fig. 4).

The reference temperature is 20 degrees C. Manufacturing tolerances for the gages are not specifically given, but for the "Go" gages they are implied in the figures given by the standard for the permissible wear, which is evenly distributed on both sides of the nominal size of the gage. Evidently, a new "Go" gage held between the same limits as the permissible wear will also be satisfactory. No tolerances are given for "Not Go" gages.

Standard in Germany

The Germans have adopted the unilateral system of tolerances, with either the hole or the shaft as the basic part. Every manufacturer can therefore choose which of the two systems is best suited to his needs. The Germans have not left the combination of hole and shaft to the designer: they have standardized twenty-two completely defined fits, each comprising an allowance and tolerances on the mating parts (see Fig. 8).

The Germans have adopted what they call four "grades" of fits. These are the "precision," the "fine," the "medium," and the "coarse" grades. By a "high grade" fit the Germans mean a fit between two mating parts that are kept between close limits. In such a case, the sum of the tolerances on the mating parts is small, and consequently there is also a relatively small difference between the minimum and the maximum clearance (or interference). The establishment of several "grades" of fits is based on the consideration (mentioned before in connection with the American system) that it may be desired to combine a certain allowance with different values for the maximum permissible clearance (or minimum permissible interference). For example, the "medium grade" running fit (sL) and the "fine grade" running fit (L) in Fig. 8 have the same allowance, but the maximum permissible clearance for the former is larger than for the latter, due to the larger tolerances.

The tolerances on the basic part are characteristic of the different grades of fit, these tolerances being different for each grade, but constant for all classes of fits belonging to the same grade. In the basic hole system, the four tolerances on the hole increase in the ratio 1:1.5:3:10, from the fine to the coarse grade. The tolerances on the shafts of the "precision" and "fine" grade fits are essentially the same. In other words, the superiority of the "precision" over the "fine" grade in this system is due exclusively to smaller tolerances on the holes. For the basic shaft system, evidently the opposite holds good.

The standard reference temperature for German gages is 20 degrees C. Definite figures are given in the standard for

the manufacturing tolerances on different kinds of gages, and for their permissible wear. Distinction is made between three classes of gages—working gages, shop inspection gages, and purchaser's inspection gages. The first two classes are essentially the same, as working gages, when partly worn, are used thereafter as shop inspection gages. Hence, the limits of the latter are kept automatically slightly wider than the limits maintained for the product by the working gages, thus guaranteeing that a part accepted by the working gages will never be rejected by the shop inspection gages. For the same reason, limits for the product set by the purchaser's inspection gages, must be somewhat wider again than those of the shop inspection gages. Therefore, purchaser's inspection "Go" gages correspond in size to entirely worn working gages.

Working "Go" gages are to be manufactured with a unilateral tolerance. This tolerance is to be given in such direction that the deviation from the nominal gage size decreases as the gage wears. In other words, new external "Go" gages must be under-size, new internal "Go" gages over-size. Both are permitted to wear past their nominal size an amount approximately equal to the tolerance on the new gage. "Not Go" gages must be made, according to the German standard, with a bilateral tolerance about equal to the tolerance on the "Go" gages, and distributed symmetrically on both sides of the nominal gage size (see Fig. 6).

The different classes and grades of fit are designated by standard terms and also by letter symbols, which allow them to be easily indicated on drawings. Also, in order to recognize the gages readily by sight and to avoid confusion in the shop, they must be marked in standard colors, as follows: Precision grade, light blue; fine grade, black; medium grade, yellow; and coarse grade, bright green.

Standard in Austria

The German national standard system has also been adopted by the Austrian national standardizing body, without modification.

Standard in Switzerland

The Swiss standard comprises both the unilateral basic hole and basic shaft systems. There are three grades of fits, numbered 1, 2, and 3, whose tolerances on the basic part increase in the same sequence (see Fig. 9). In the basic hole system, seven classes of fit belong to grade 1, ten classes to grade 2, and four classes to grade 3. It comprises, therefore, twenty-one completely defined fits. The symbol for a fit consists of a letter indicating its class, followed by a numeral indicating the grade. The letters A to L, inclusive, are used for the basic hole system, and the letters M to Z, inclusive, for the basic shaft system. In case a specific diameter is mentioned, this is placed before the fit symbol. Thus, 40 D-2 refers to the running fit D, basic hole system, grade 2, for mating parts with a nominal diameter of 40 millimeters.

The reference temperature for gages in Switzerland is 20 degrees C., or 68 degrees F. No manufacturing tolerances are given for either "Go" or "Not Go" gages. The standard specifies a permissible wear for a "Go" gage which is unilateral and upward from the nominal gage size for an external gage, and downward from nominal size for an internal gage. The permissible wear equals about 25 per cent of the tolerance on the product. The standard also indicates the kind of gages that shall be used for the inspection of parts having different diameters and belonging to certain grades of fit.

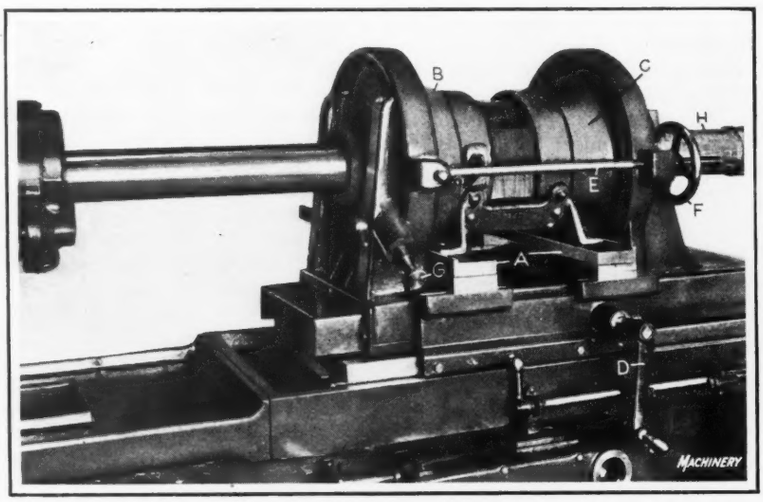
Standardization Work in Progress

The national standardizing bodies in Belgium, Czechoslovakia, Italy, Norway, Poland and Russia, have taken up the development of a standard system of tolerances. As no definitive standards have been established in these countries up to the present time, this work will not be discussed. Work in progress in the American sectional committee has been mentioned before in the discussion of the tentative American standard recently issued.

* * *

GRINDING THE BORE OF STATORS

Stators having a bore of between 5 and 8 1/4 inches in diameter are ground to size within plus or minus 0.002 inch at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. The operation is performed on an internal grinding machine equipped with the special fixture shown in the illustration, about 0.0015 inch of stock being removed from the laminations. The stators are located vertically in line with the center of the grinding wheel by seating them on the hardened and ground bars *A*. Sidewise location is readily accomplished by means of rings *B* and *C*, which are mounted on heads that can be moved apart longitudinally without disturbing the position of bars *A*. After the stator has been placed on these bars, it is centralized sidewise with the grinding wheel as rings *B* and *C* are advanced over the machined end rings of the stator frame. The heads on which rings *B* and *C* are mounted are held together for the operation by lowering the right-hand end of bar *E* into the position shown, and then tightening handwheel *F*. Parts from 3 to 28 inches long can be accommodated between rings *B* and *C*.



Set-up of Internal Grinding Machine for grinding the Bore of Motor Stators

About five passes of the wheel are necessary to grind the work to the desired accuracy, and these passes are accomplished automatically through trips on a bar running along the front of the table. The wheel is trued by means of a diamond operated through knob *G*. At *H* may be seen a dust exhaust pipe, which is attached to the right-hand head to draw all grinding dust from the bore of the work.

* * *

With a view to bringing the subject of the prevention of accidents into the continuation schools in New York City, arrangements have been made to instruct the teachers in these schools in the principles of industrial safety, the instruction being given under the auspices of the New York State Department of Labor. The instruction is in the form of a course of lectures which are given weekly during the spring months before bodies of teachers in order to provide them with the most recent information in regard to accident prevention in industry. The number of children engaged in industry that are now receiving education in continuation schools in New York City is approximately 50,000, so that the inauguration of safety lectures in these schools serves a broad purpose that may be used as a suggestion for similar courses elsewhere.

MACHINE MODELS

By S. W. BROWN

The building of models is part of the work that necessarily precedes the marketing of a newly invented machine. Models are usually built for complicated machines that are to be manufactured in large lots by special tool equipment. It is desirable to build models for three purposes: First, to enable the inventor to demonstrate the practicability of his invention; second, to permit the machine designer to prove or check his working drawings; and third, to permit the manufacturer to check the accuracy of the jigs, fixtures, and patterns in the actual construction of one machine before attempting to build a large lot. It is seldom that all these factors can be checked in building one model, the number of models required ranging from one in rare cases up to ten or twelve according to the difficulties encountered. As many as eighteen models were built for a certain office appliance that is now on the market, but this was an unusual case. Nevertheless, the developing of an invention of a complicated nature is not an easy matter.

It is the object of this article to outline a method whereby the preliminary mechanical work on an invention may, in some measure, be systematized, in order to save time and expense. Let us assume that a complicated machine is to be developed from the inventor's idea, and carried through to the successful marketing of the finished product in large lots. For an invention of this type, it is desirable, if not necessary, to build three models. These models may be termed, for the sake of clearness, the inventor's model, the designer's model, and the manufacturer's model.

The Inventor's Model

When an inventor has an idea for constructing a new machine and decides to demonstrate the practicability of the idea, the first step is to build a model. Ordinarily, an inventor is not a machine designer or a manufacturer; hence he is not concerned with, and does not understand, the problems confronting the designer and the manufacturer. He naturally concentrates his efforts on the problem of making his model operate. The inventor may obtain his model in various ways. Occasionally he builds it himself or hires one or more machinists to build it under his directions. Again, he may make a set of drawings and have the machine built in some shop.

Let us assume that after experimenting, changing, and possibly building several models, the inventor has succeeded in obtaining a model that operates satisfactorily. He is now ready to turn his attention to its manufacture. If it is his first attempt, he is likely to be disappointed when he learns that manufacturing from his model is out of the question until more preliminary work is done. An inventor's model is not usually an artistic piece of work, although some models have a neat appearance, are well designed, and show good workmanship. In most cases, the model undergoes so many changes that it has a patched appearance and is quite unsightly. Then, too, the same mechanical motions performed by the model can often be obtained by employing fewer parts. Again, the material from which the model is made may not always be suitable for quantity production methods. Hence, it is seldom, if ever, practical to "tool up" and manufacture directly from the inventor's model. However, if the principles of the invention are sound, the remaining preliminary work may be carried out systematically. In most cases, time and money could be saved by employing a machine designer to assist in building the first model.

The Designer's Model

A designer's model is, practically speaking, an inventor's model that has been redesigned to permit economical manufacture and, in some instances, to incorporate new features. The inventor's model should be given to a competent machine designer who should adhere to the inventor's principles, but accomplish the desired results as economically as possible. The designer should also consider the purpose for which the machine is intended, and design the exterior accordingly.

A perfectly plain machine presents a good appearance, is easy to clean, and in most cases is preferable. However, an ornamental exterior is sometimes desirable. If castings are used in the construction of the machine, the patterns for these should be made with a double shrink, so that they may be used later in making metal manufacturing patterns. The designer's model should be built accurately to the drawings, so that in case the machine does not work properly, the errors may be located by a careful checking of the drawings. If, for any reason, changes are made in the model, the drawings should be changed to agree with the model. It is practically useless to make a model operate by experimenting and making changes, unless an accurate record is kept of the changes, so that the model can be duplicated.

After the designer's model is built and in satisfactory operation, it is a good plan to build a small lot of, say, six machines exactly like the model, employing stock tools and equipment or, perhaps, a few inexpensive temporary jigs and fixtures. These machines should be distributed to prospective purchasers for the purpose of giving the invention a thorough trial. If, for any reason, the invention proves to be a failure, the cost of an expensive set of jigs and fixtures and the expense of building a large lot of machines is saved. If the trial machines are successful, the required jigs, fixtures, and metal patterns may be made from the designer's set of drawings. On the completion of the manufacturing equipment, it is desirable to build another model—namely, the manufacturer's model. If the special tool drawings are checked very carefully with the designer's drawings, and the special tools and patterns are rigidly inspected, the manufacturer's model may be omitted, in some cases, but the writer does not recommend this practice.

The Manufacturer's Model

In building the manufacturer's model, the new set of jigs, fixtures, and patterns is employed. The building of this model is the best kind of a check for the latter equipment. If there are any errors in the equipment, the fact will be apparent when the model is assembled or tried out. Corrections can then be made before building a large lot of machines. If the operation and appearance of the model is satisfactory, its manufacture may proceed at once. To save time, manufacturing need not be entirely suspended during the building of the manufacturer's model, as meanwhile, many of the parts may be machined, leaving only the doubtful ones to be made up after the model is completed. The set-ups used in machining the parts may be kept intact until the model has been completely assembled and tried out. If the model operates satisfactorily, the manufacturing operations may then proceed.

Short-cuts

To build three models, and an additional small lot of machines, may seem a long and tedious process. There are so-called "short-cuts," such as tooling up and manufacturing from the designer's or inventor's set of drawings, but these and other "short-cuts" simply mean taking chances. The methods and suggestions outlined in this article have been employed by the writer during many years of experience as foreman of an experimental and model department, and have proved to be successful. The procedure is, of course, modified in some cases to suit special requirements, but the methods outlined are generally employed.

* * *

In an article relating to the machinery trade of Brazil, published in *Commerce Reports*, it is mentioned that the federal government of Brazil buys most of the machinery and supplies for the national railways, the national shipping, and the army and the navy, by calling for public bids. In calling for bids on machinery, detailed specifications are rarely used. Bids are only received from local firms or individuals. A foreign manufacturer desirous of taking part in the bidding must do so through a locally established representative, who must have papers showing his legal right to act for his principal.

Small Belt Drives

Their General Application, Types of Belts Used, and Design of Efficient Pulleys

By JOHN MORRIS COMBS, The L. H. Gilmer Co., Philadelphia, Pa.

THE speeding up of machines to increase production in the last few years has presented new problems in small belt drives. Twenty years ago, when pulley speeds were comparatively low, the round leather belt, fastened at the ends with a more or less clumsy coupling, may have been adequate for small belt drives, but then drives were simple, compared with modern drives that may require the belt to run over half a dozen pulleys or even more, frequently with complicated turns through various angles and at speeds as high as 9000 or 10,000 feet a minute on pulleys a few inches in diameter.

For example, in the autoplate machine, which is used for casting the stereotype plates from which newspapers are printed, the specially woven endless fabric belt meets an unusual set of mechanical conditions by operating over five pulleys. (See Fig. 2.) The small diameters of these pulleys make it necessary to use a very flexible belt to avoid excessive consumption of energy in internal work, as the belt bends and straightens out again in passing over the pulleys at high speed. As an example of high belt speed, a centrifugal separator of widely known make has an endless flat-cord belt running successfully at 9000 feet a minute. (See Fig. 3.)

When designers of machinery attempted to employ high belt speeds, it was found that the resulting internal friction and heating in leather belts caused them to dry out and crack, destroying the life of the belt. The methods that it was necessary to use in joining the ends of the belts also made them slip and jump on small pulleys or spindles, causing the machine to run irregularly and vibrate. It was to meet these conditions that endless woven fabric belts were invented in 1903 by Ludwell H. Gilmer, of Philadelphia. Today, such belts are used extensively on internal and surface grinders, routing machines, and on many other classes of small belt drives. Practically all automobile fans are driven by endless fabric belts, but because of the severe conditions under which the belt must operate, the fabric frequently is combined with rubber.

JOHN MORRIS COMBS was educated in chemical engineering at the University of California, Johns Hopkins University, and the University of Chicago. He taught chemistry in the High School at Mansfield, Ohio, for one year, after which he became general manager of the Troy Foundry & Machine Co., Troy, Ohio. For two years, he was with the Viscol Co., East Cambridge, Mass., manufacturer of rubber substitutes and waterproofing compounds, first as chemist and later in sales promotion work. Mr. Combs was then engaged for several years in editorial work. For the last few years, he has devoted his attention to writing on technical and mechanical subjects. In this work, he has been associated with a number of large corporations, including Henry Disston & Sons, Inc., the American Engineering Co., Keasbey & Mattison Co., Asbestos Buildings Co., American Fluid Motors Co., Asbestos Shingle, Slate & Sheathing Co., and the L. H. Gilmer Co.

Following the improvement in the belts themselves, not only were machines speeded up, but in many cases it was found practicable to redesign them more compactly and simply, saving floor space and reducing the number of parts. The steadiness of the drive due to the low stretch, low slippage, and flexibility of the flat woven belts has been found to be especially valuable in the case of grinding machines, routers, and other small machines in which vibration or jumping of the spindle would damage the work.

Turning to the familiar surroundings of the home, we find that the high-speed woven belt, either flat or molded with rubber into a vee-shape, is used for driving the family washing machine, the home refrigeration unit, the dishwasher, vacuum cleaner and other devices that make "electric housekeeping" possible. Designers of machines for domestic use have to bear in mind that probably nowhere else does a belt receive harder

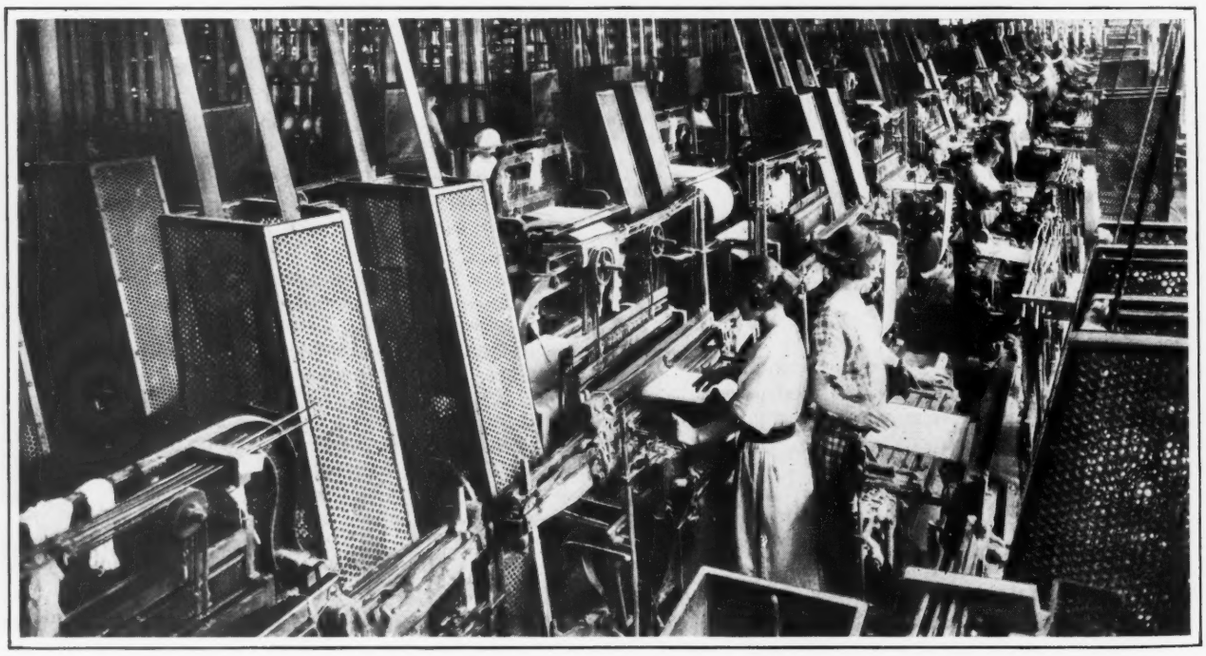


Fig. 1. Weaving Tubular Webbing for Endless Belts which are made by cutting Sections from the Webbing and folding the Edges Inside, as shown by the Cross-section, Fig. 7

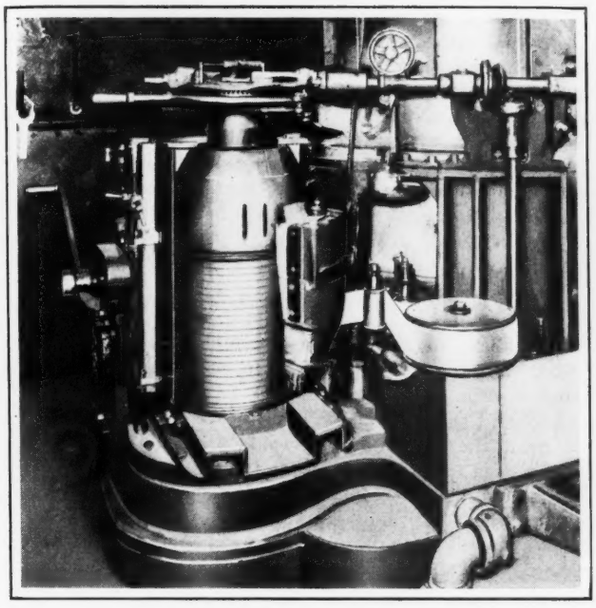


Fig. 2. Autoplate Machine having Woven Endless Fabric Belt which runs over Five Pulleys

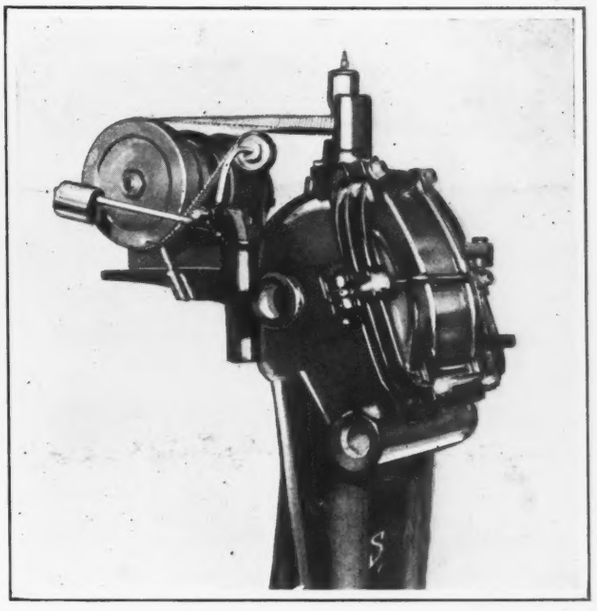


Fig. 3. Separator driven by Woven Endless Flat-cord Belt running at 9000 Feet a Minute

treatment than in the home. There is no skilled attention, and such belts often drive machines that are not sufficiently or properly lubricated. Frequently, especially in the case of washing machines, the belting is subjected to the dampness of the cellar air. On machines of this type, the best form of belt has been found to be cord fabric encased in rubber, for it gives satisfactory service even when subjected to much abuse. This form of belt also is the one that is most used for driving automobile fans.

The necessity for automatic operation often tends to increase the complexity of the drives, so that it is not unusual to find belts running over several pulleys. At the same time, space limitations frequently compel the use of small pulleys and short center drives. Such a drive, found in a widely used washing machine, is shown in Fig. 4. It will be noted that there are four pulleys, with the smallest only 1 1/4 inches in diameter, and the others only 2 1/2 inches. A drive of this kind imposes severe demands on a belt; yet we find these household machines in constant service month after month with practically no belt trouble.

When a belt is running over a pulley, the inside of the belt is compressed and the outside is stretched. For this reason, a belt of the cord fabric and rubber type should have the cords on which its strength depends placed at the "neutral axis" in the center of the belt, where the dimension is constant, with rubber on the inner and outer sides to take the compression and stretching. In this way, internal friction is reduced to a minimum, and the maximum flexibility is attained. These are especially important considerations when the diameters of the pulleys are small and the speed high.

Types of Small Belts

Many kinds of small belts have been evolved as the result of intensive study of this subject, but all fall into three general classifications: The V-belt *A*, Fig. 5, molded to fit a groove in the pulley; the cylindrical or round belts *B* and *C*; and the flat woven belt *D*. The flat belt may or may not have rubber added to the fabric base, depending upon the use to which it is to be put.

The capacity of a belt to transmit power depends upon the tension, the coefficient of friction, and the area of contact. By giving a belt the V-shape, the area of contact is greatly increased, for contact is along the sides. The area of contact also is increased by the wedge action of the belt in the groove, which forces the belt against the sides of the groove, and insures that the entire surface of the belt passing over the pulley actually will be in contact with it. The V-belt gives maximum power transmission for a given width of pulley.

Cylindrical or round belts may be of the rope type, as shown at *B*, or of the endless web type, as at *C*, the construction of the two types being clearly shown in the illustration. Round belts transmit the maximum power when used in V-shaped pulley grooves. A round belt in a half-round groove, as shown at *A* in Fig. 6, transmits only the same amount of power as a flat belt having the projected area of the cylindrical belt and running on a flat pulley. A round belt in a V-shaped groove, as shown at *B*, will compress laterally and wedge itself into the groove so that it acts, in effect, as a V-belt. Wear still further flattens the sides of the belt and tends to increase this effect, as shown at *C*.

Flat belts *D*, Fig. 5, are made in a wide variety of weaves. There are fundamental differences, too, in the manner in which they are made endless. One of the best methods of making a small endless belt is to weave it in two plies that can be readily separated for splicing. Such a belt is really two belts woven as one (not sewed together), with all the strength, uniformity, and smoothness that come from being

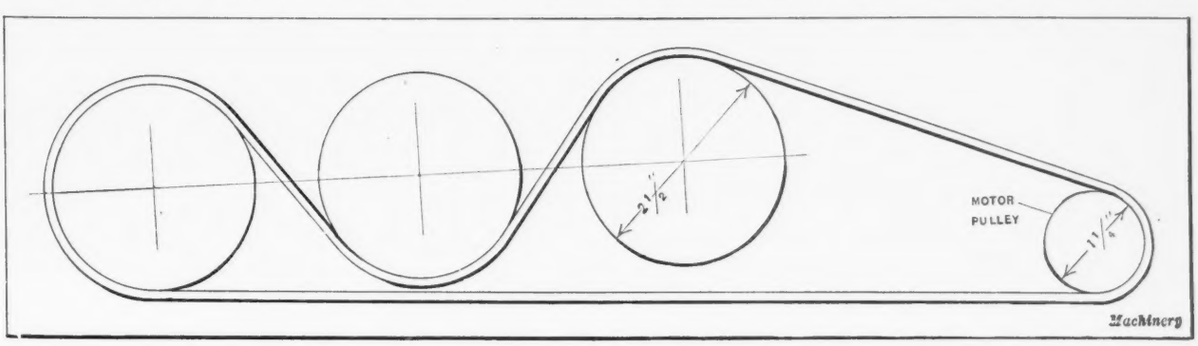


Fig. 4. Four-pulley Flat-belt Drive which operates satisfactorily notwithstanding Unfavorable Conditions

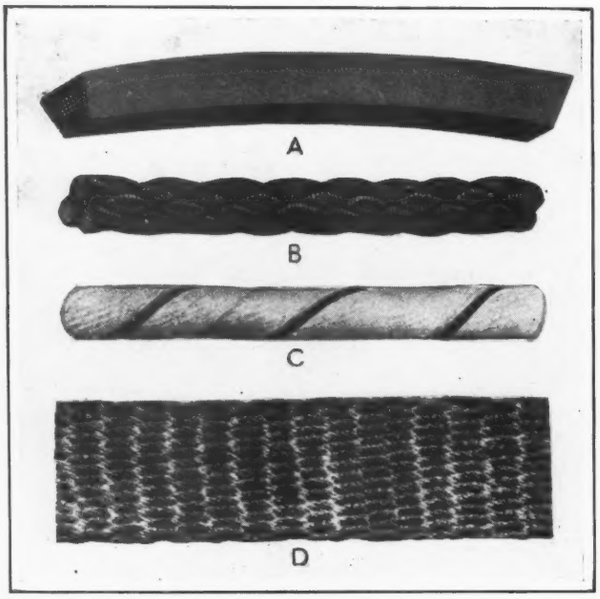


Fig. 5. (A) Molded V-belt with Cords at Neutral Axis; (B) Round Endless Rope Belt; (C) Round Endless Web Belt; (D) Hand-woven Flat Endless Belt

woven as a single unit, yet requiring only a pair of scissors to separate the plies. In joining the ends of such a belt the plies are separated for about 2 inches at each end of the piece. The top ply is cut off at one end and the bottom ply at the other end for exactly the same distance; the ends are brought together with the plies overlapping, and the job is completed by sewing them together. The splice so obtained is of the same thickness and flexibility as the rest of the belt, insuring smooth, even running.

Another type of flat cord belt is woven endless without laps, joints, or splices of any kind, and uniform throughout. These belts, which are made by hand, give a maximum of flexibility and smooth running, combined with low stretch and low slippage. They are designed for use where an even,

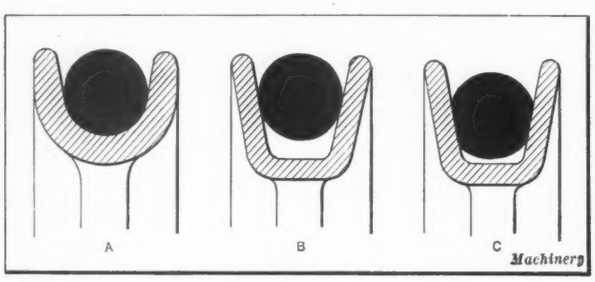


Fig. 6. (A) Round Belt in Half-round Groove; (B) Round Belt in V-groove; (C) Effect of Wear and Compression on Shape and Position of Belt

vibrationless drive is especially important. When conditions make it necessary, they can be impregnated with rubber.

Still another type of flat belt is made by cutting sections from webbing, woven in tubular form, and folding the edges back into the interior of the belt, as shown in Fig. 7. The belt is then stitched, to hold the three layers in place and prevent raveling of the folded edges. The weaving of the tubular webbing is shown in Fig. 1. The internal diameter of the tubes of webbing must be slightly greater than the length of the belt, measured along its inner surface, to allow for the thickness of the webbing folded inside the belt.

Ratio of Pulley Diameter to Belt Thickness—Belt Speeds

Whatever the type of belt used, the ratio of pulley diameter to belt thickness should be as high as possible. The more flexible the belt, the lower the ratio can be, but it is not advisable to go below a ratio of 10 to 1 with V-belts, or 20 to 1 with flat belts. Although the ratio with flat belts is higher, the actual size of the pulleys can be smaller than with V-belts because of the thinness of the flat belt.

Whether a flat belt or a V-belt should be used depends largely upon the power to be transmitted and the speed at which the belt must be run. The V-belt will be found to operate satisfactorily at speeds as high as 3500 feet a minute, while with flat belts on small pulleys, speeds up to 10,000 feet a minute are practicable. Single V-belts of 3/4 inch width, running at 3500 feet a minute on correctly designed pulleys, will transmit up to three horsepower. If more power than this is to be transmitted, it will be found better practice to use twin belts, as shown at *C*, Fig. 8, rather than to increase the size of the belts.

Pulley Grooves for V-belts and Crowning for Flat Belts

The pulley groove for a V-belt should be at least 3/16 inch deeper than the belt thickness to provide clearance, as indicated in Fig. 8. A clearance of 1/4 inch is better, and usually will be found ample in any case. A V-belt must not bottom in the groove, as this would prevent the proper contact between the sides of the belt and the sides of the groove, and would seriously reduce the ability of the belt to transmit power. The width w of the pulley groove across the top of the vee should be the same as the width of the belt, with a permissible tolerance of 1/32 inch. The sides of the groove,

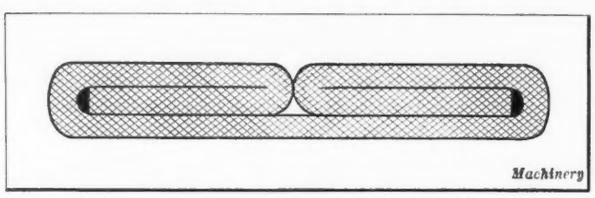


Fig. 7. Flat Woven Belt made by cutting Sections from Tubular Webbing (woven on Machines shown in Fig. 1) and folding as shown

which form the contact surfaces, should be smooth, care being taken to avoid ridges, tool chatter marks, and other defects, as these cause rapid belt wear. The rim of the pulley should be as light as possible, as shown at *B* in Fig. 8, except when a flywheel effect is desired, in which case the mass of metal in the rim should be increased, as shown at *A*.

Extensive experiments by the L. H. Gilmer Co., extending over many years, have resulted in a recommended angle a of 38 degrees for two-pulley drives. An included angle of 28 degrees is recommended for the smaller pulleys of a three-pulley drive, due to the reduction of angular contact in this arrangement. The thickness t of a V-belt should be from 0.5 to 0.6 of the width w at the widest part of the vee.

In two-pulley drives with flat belts, the larger pulley only should be crowned, and the smaller pulley should be flat, flanges being used, if necessary. The distance between the flanges should exceed the belt width by at least 10 per cent. In most cases, the crowning on the larger pulley may be figured at 1/16 inch for each inch of width, but there are many factors that influence this, so that no hard and fast rule can be laid down. In general, the higher the belt speed, the less crowning will be needed.

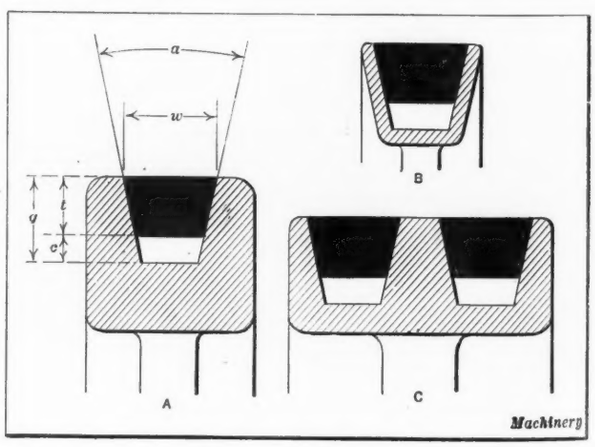


Fig. 8. (A) Heavy Pulley for V-belt Drive; (B) Light Pulley; (C) Pulley for Twin-belt Drive

The amount of take-up, or adjustment for belt stretch, that need be provided for varies, but as a rule, 5 per cent of the belt length is ample. In dealing with small belts, it is important to remember that formulas and rules which have been worked out for large belts are usually true only within certain limits, and do not necessarily apply to small belts. The latter are a problem in themselves, and are well worth separate study.

* * *

APPRENTICES IN ROCKFORD MACHINE TOOL PLANTS

By EDWARD ANDERSON, Instructor of Apprentices, Continuation School, Rockford, Ill.

It has been the plan in Rockford, Ill., for the last eight years, to have machinist apprentices obtain their technical instruction through courses offered in the public schools. The continuation school established for this part-time instruction has been handling not only the machinist apprentices, but building trades apprentices as well. The machinist apprentice is in the continuation school one-half day a week, where he is instructed in mathematics, mechanical drawing, and such work in science as may be closely related to his shop work.

Actual shop practice is not being offered to apprentices during their school hours, because their employers are in a better position to teach shop practice through the regular shop work. Instruction in lay-out work is given, however, and the boy is instructed in the reading of such precision instruments as the micrometer and height gage, and in the use of Johansson gage-blocks.

Aside from the apprentice course, there is a "trade course" for machinists. This course is given by the industrial department of the high school, and is intended for the full-time high school student who contemplates entering an apprenticeship after finishing high school.

Along with the mathematics, drawing, shop science, and lay-out work, the apprentice is given a course of instruction in the use of MACHINERY'S and the *American Machinist's* handbooks. The handbook lessons are in the form of typewritten lesson sheets covering practically all phases of shop processes. There are lesson sheets on grinding, selection of the proper grade of stone, spur gears, bevel gears, spiral gears, etc. The lesson sheets do not attempt to make any explanation of a problem, but simply put a problem before the apprentice and refer him to certain pages of the handbook for the explanation, or show where the results can be obtained from the many handbook tables.

The object of the handbook course is to help the boy to form correct habits of referring to handbooks and to become thoroughly familiar with them, so that he can find what he wants quickly and accurately. Employers who are taking advantage of this training for their apprentices are showing considerable interest, and are actively cooperating with the school to help make it a success.

From time to time representatives or employers from the factories come to the apprentice classroom and give talks on subjects of especial interest. In this way, employers and apprentices meet on a sort of neutral ground, where they can become better acquainted.

Another feature of the work, as handled by the school, is the conducting of trips through the many machine tool plants and factories of Rockford, as well as to plants in other cities. Among the plants that have been visited are those of the Fairbanks-Morse Co., of Beloit, Wis., and the Elgin National Watch Co., of Elgin, Ill. In making the trips through the factories, the classes are divided into small groups of four or five, so that the trip is educational and instructive, rather than a mere sight-seeing trip. The manufacturers are always willing to grant permission for the apprentices to go through their plants. Such trips are very instructive to the apprentice, and they tend to broaden his vision of the machinist's trade as a whole. He soon begins to take pride in the fact that he is a machinist apprentice.

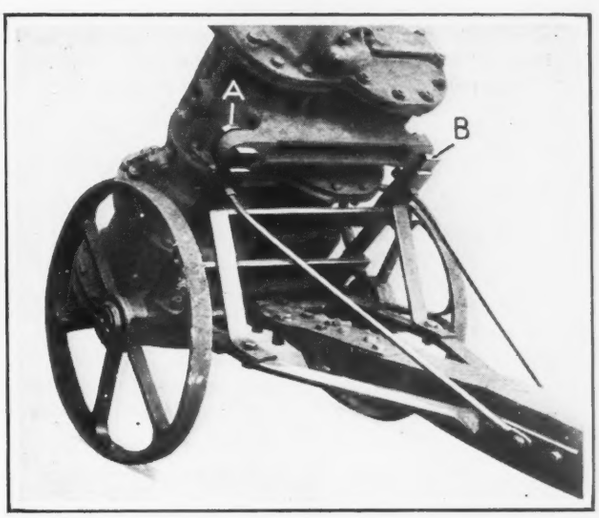
The apprentice is paid for his time in school at the same rate as that for which he works in the shop. The attendance is recorded on a small card, with the apprentice's name and the number of hours he has been in school, and is signed by the instructor in charge. At the close of each class session, the card is given to the apprentice, who presents it to his foreman or the timekeeper of the factory where he works.

* * *

SPECIAL HAND TRUCK FOR MOVING AIR PUMPS

By W. M. CAVIN, Foreman, Air Brake Department, Emerson Shops, Rocky Mount, N. C.

Moving a repaired pump away from the work-stand usually requires three additional men to assist in placing it on an ordinary hand truck, for an 8 1/2-inch cross-compound pump weighs approximately 1500 pounds. In addition to the extra labor required, there is always more or less danger of the pump slipping and causing an accident. To eliminate this trouble and reduce the amount of labor required, a special two-wheeled truck or "pump buggy" was designed and built (see illustration). This has two 30-inch wheels provided with ball bearings. The pump is supported by a frame which



Truck that enables One Man to easily move an Air Pump weighing 1500 Pounds

fits the bracket or lugs used for holding the pump on the locomotive. This frame merely has two forks or openings at *A* and *B*, which securely hold the pump without bolting or clamping. The wooden handle is 9 feet 7 inches long measured from the center of the axle. With this improved truck, the smallest man in our air brake department, who weighs only 118 pounds, can easily and safely move an 8 1/2-inch cross-compound air pump.

* * *

BUSINESS CONDITIONS IN GERMANY

Business conditions in Germany are not satisfactory, and reports from that country leave much to be desired. Assistant Commercial Attaché Douglas Miller, at Berlin, recently reported to the Department of Commerce at Washington that 50,000 business firms in Germany discontinued business during the past year, the larger proportion of these by voluntarily dissolving and going out of business. The greatest part of these business mortalities have taken place since the crisis in business last October. Widespread unemployment continues, and there is a further reduction in coal and metal mining. It is also reported that at least one-third of the total plant capacity of the metal-working industries is unused. Prices obtainable for the products are too low to permit of profitable operation. Collections are slow, and high interest rates retard business. Domestic business generally is declining, but a slight increase in foreign orders is reported; the Leipzig Fair probably had something to do with this, there being a fair amount of foreign interest shown in German machinery.

Standardization of Gear Teeth in Germany

IN July MACHINERY, page 905, an article was published relating to the proposed American standard spur gear tooth form. Owing to the importance of this general subject, the following translation of a report on proposed gear tooth standardization in Germany has been secured. The information that follows is based upon a report by Dr. Bauersfeld, chairman of the Committee on Gear Teeth of the N. D. I. (Normenausschuss der Deutschen Industrie).

After considering the standardization of gear teeth for several years, the gear committee of the N. D. I. proposed a standard tooth. This standard was published in the N. D. I. *News* in October, 1925, and as a number of interested firms and experts have commented on this proposed standard, the more important points referred to will be presented to show how it was received and the nature of the objections against it. This report will also serve to indicate the present stage of gear tooth standardization in Germany, as well as the motives and reasons of the committee for tentatively adopting this standard. The various features relating to it will first be given, and these will be followed by a summary of the comments.

1. The basic rack is a straight-sided or unmodified involute rack.
2. The pressure angle equals 20 degrees.
3. The total tooth depth equals 2 × circular pitch ÷ 3.1416 = 2 × module. (It will be understood that all dimensions are in millimeters.)
4. The tooth thickness and width of the space as measured along the pitch circle are equal.
5. Clearance equals 0.1 to 0.25 × module.
6. Radius of fillet at root of tooth equals 1.5 × clearance.
7. Certain tip and root modifications are admissible to compensate for errors in tooth spacing.

Basic Rack and Pressure Angle

There were no objections to the adoption of an unmodified involute rack as standard. As to the pressure angle, notwithstanding the fact that the majority of firms now use 14 1/2-degree and 15-degree angles, the proposed 20-degree standard met with a favorable reception. This was due to the fact that gears having a 20-degree angle and normal height of tooth may be produced down to 17 teeth without under-cutting and without resorting to special methods, such as "profile shifting" or tip and root modification. With a pressure angle of 15 degrees, 30 teeth is the limit for undercutting. The larger pressure angle also gives more favorable values with respect to strength and surface pressure.

Although the majority favored the 20-degree angle, objections from those desiring to adhere to the 15-degree angle were based chiefly upon the high cost involved in making a change due to the replacement of large stocks of tools. However, even if the 20-degree angle were adopted, the old 15-degree system would naturally be continued for a number of years. In this connection, the gear committee considered whether or not tables for the 15-degree system should be issued pending the general adoption of the new standard, but this proposal has not been advocated, because of the confusion that might arise.

Various communications received showed that the 20-degree angle is now being used extensively in Germany, particularly in the automobile industry where about one-third of the manufacturers have adopted this angle. Some firms suggested increasing the angle to 21, 22 1/2 and 24 degrees, in order to further limit under-cutting. Others favored considerable latitude in the selection of angles, thus making it possible to use angles of 15, 17 1/2, 20, 22 1/2, 25, 27 1/2, and 30 degrees, according to conditions.

Although the angle of 20 degrees is not considered the best for every application, it is believed that the purpose of standardization is realized when the standard is applicable to a large majority of the cases involved. Whenever, for certain reasons, a deviation from the 20-degree standard is desired, it is considered preferable to leave the selection of the angle to the manufacturer instead of attempting to fix definitely a series of angles for such special applications.

The Total Tooth Depth

The rule for the whole depth of the tooth, which up to the present has been employed largely for 15-degree gears, has also been quite generally approved for the proposed standard. A small number of firms were very emphatic about the standardization of a stub tooth having an addendum equal to 0.75 or 0.8 times the module. The Dutch standardization committee also prefers 20-degree stub teeth having an addendum equal to 0.8 times the module. The advantages cited are lower production costs due to reduction in machining time, reduction in friction and wear, and increased strength. Since stub teeth are used extensively in America, the gear committee considered all proposals carefully. A special standard stub tooth for German manufacturers was not advocated for two reasons: First, if the addendum is made equal to 0.8 times the module instead of making it equal to the module, the amount of overlap and the arc of action will be reduced considerably. Theoretically, the number of teeth in contact might be just above the value 1, but practically, a liberal excess or overlap is required if the sides of the teeth are to be modified to secure smooth quiet running.

The second and perhaps more important reason for retaining the full tooth depth is that it presents a larger wearing surface than a stub tooth, and consequently, wear is reduced. This fact has been proved in a most surprising way by many experiments conducted by the American standardization committee. It was found that the life of gears having full-depth teeth was considerably longer than those with stub teeth, the results indicating an increase in durability ranging from 300 to 400 per cent. In view of these results, it is not to be supposed that in America the stub tooth will be made the only standard, and this should not be done in Germany either.

Whether a second standard for stub teeth should be created for use where smoothness of running and wear are not of chief importance, is another question. It must be admitted that stub teeth have the advantages of economy and greater rigidity or strength, as previously mentioned. The gear committee so far has assumed a neutral attitude toward this question, pending the receipt of additional comments from manufacturers.

Tooth Thickness and Clearance

The tooth thickness and width of the space as measured along the pitch circle are made equal, so that if two gears are located at the standard or normal center-to-center distance, there will be no side play. To obtain the desired side play, therefore, the center-to-center distance has to be increased. There have been no objections to this proposal.

The plan of making the clearance equal to 0.1 to 0.25 times the module has resulted in a number of counter-proposals. Some firms object to the fact that there is no definite value fixed for determining the clearance. The proposals for such a fixed value differ, some advocating 1/6 times the module, others 0.2 times the module, and still others 1/8 times the module plus 1/8 millimeter. The latter value is intended to provide larger clearances, relatively, for small modules than for larger ones.

The gear committee endeavored not to fix in the standard any more values than are necessary for interchangeability of the gears, and particularly to avoid fixing dimensions, the selection of which might depend upon the manufacturing

method. This applies especially to clearance. In producing gears by the hobbing method, a clearance value equal to 0.1 times the module should be ample, since it is assumed that the gears will be adjusted in assembling to provide a slight side play, which also increases the clearance. The selection of larger clearance values is left for gears that may be produced by the Fellows system, and moreover, it is extremely desirable to have ample clearance for gears to be finished by grinding. Several firms even advocated that the clearance range be extended to 0.3 times the module on account of grinding. Owing to the increase in the use of ground gears, this point will be considered carefully by the gear committee. The proposals to fix definite values for determining clearances might be acted upon favorably, if the dimensions of tools used in gear manufacture were fixed by standardization. Even then, varying values for clearance, according to the type of tool used, would be advisable.

Radius of Fillet at Root of Tooth—Modification of Profile

A radius equal to 1.5 times the clearance has been proposed, so that the arc will be tangent to the side of the tooth at the clearance line. There have been few objections to this proposal. Some advocate that the radius be equal to the clearance, whereas others desire a certain latitude, recommending values from 1 to 1.5 times the clearance.

As to the modification of the profile, a number of interested firms have decided opinions about this proposal. The object of the proposal was to allow a certain latitude in easing off the tooth, especially at the tip, in order to increase smoothness of running. The gear committee had to take this modification into consideration, but the question was to determine whether or not it should be made obligatory by fixing definite values or whether it should be left to individual discretion. The committee decided in favor of the latter plan, it being understood that the modification is within a true involute and not outside of it, the modification being in the nature of a removal rather than an addition of gear tooth material. This provision insures that all gears made to standard, whether modified or not, will be interchangeable.

The objections do not apply to modification as such, but are all directed against the indeterminate amount of modification which, according to the standard proposal, should be in proportion to the dividing errors to be expected. In these comments from manufacturers, there are three classes of counter-proposals which are as follows: (1) Fixing definite values for modification dimensions; (2) fixing limits for modification dimensions; (3) limiting modification to the tip of the tooth.

It is not feasible to enforce the first counter-proposal, since this would restrict manufacturing methods, and grinding, especially, would offer great difficulties. Furthermore, for all applications where profile modification can be dispensed with, production costs would be increased unnecessarily if modifications were made. Fixed values would also make it impossible to select modification dimensions based upon the most favorable conditions for smooth running. Thus, the more precise the manufacturing method is, regarding exactness of division and tooth shape, the smaller must be the modification if smoothness of running is actually to be improved by it. The number of teeth should also be considered, a comparatively large number requiring less "easing off" or modification than small numbers.

It might be advisable to consider the second counter-proposal, and give in a standard table the maximum limits for modification dimensions in proportion to the module. The gear committee will reconsider this question. The third counter-proposal would place a restriction upon different manufacturing methods; moreover, it would lose its importance if the modifications within a maximum limit were allowed. It might be well to mention that in the large majority of communications received, there were no objections to the proposal concerning profile modification.

In some communications, it was pointed out that standardization should not tend to eliminate special gears for special purposes, and the committee fully agrees with this. As an example, gears for electric locomotives might be mentioned. Thus, it is expected that the present method of "profile shifting," as applied to this gearing, will be retained. To what extent it might be advisable to adopt a 20-degree angle for these gears can be determined only by further experiments.

Some contend that gear standardization should be deferred until the subject has been examined more carefully. For instance, one firm in the automobile industry points out that the conditions essential to quiet running are not as yet fully known. It is particularly important to have the German standard agree with the American standard regarding the main points, if this can be arranged. According to the proposed American standard, the basic rack for the 14 1/2-degree composite system (full-depth tooth) has cycloidal curves at the top and bottom (see illustration on page 905 of July MACHINERY). This composite system naturally takes care of special requirements, but it appears doubtful whether such standardization would offer any material advantage to industry over the present standardless condition. The German committee has repeatedly stressed the opinion that only one profile should be adopted as standard; otherwise, simplification of manufacturing methods will not be attained.

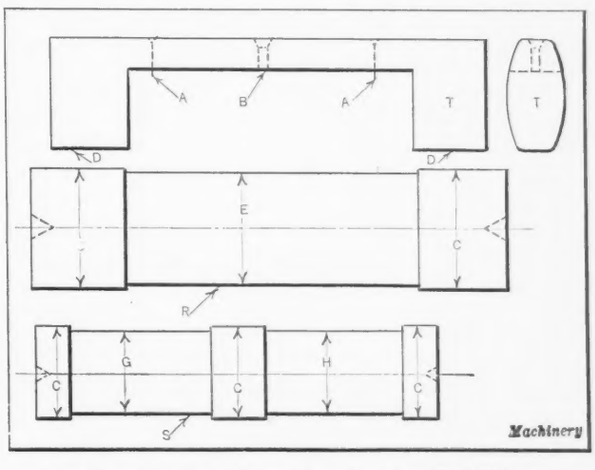
* * *

FORMING GEAR TOOTH PATTERNS

By A. W. JANSSON

A wooden templet for use in whittling out gear tooth patterns is described on page 657 of April MACHINERY. A similar templet, but one used in a somewhat different manner for forming pattern teeth, is shown at *T* in the accompanying illustration. The wooden blocks, sawed out roughly to size, are secured in the opening or slot in templet *T* by a screw passing through hole *B*. Two small sharp steel points or brads at *A* keep the work in proper alignment.

After a rough sawed block is placed in the templet, it is finished to the exact outline of the templet by a sanding roll



Templet and Sanding Rolls used in making Gear Tooth Patterns

like that shown at *R*. The sanding roll is made by turning down the center *E* to a smooth uniform diameter for a length slightly greater than the length of the tooth pattern to be made. On the turned-down center of the roll is glued garnet sandpaper. When the glue has become thoroughly dry, the ends *C* are turned down flush with the sandpaper surface. Thus the roll has a uniform diameter for its whole length. The formed ends *D* of the templet *T*, coming in contact with the wooden surfaces *C* of the sanding roll, prevent sanding away the tooth pattern below the profile line, and thus enable the workman to produce a tooth pattern having the same profile as the templet *T*.

In making accurate tooth patterns from mahogany, a sanding roll like the one shown at *S* is employed. This roll has two turned-down sections, the one at *G* being covered with a coarse sandpaper, and the one at *H* with fine sandpaper. The coarse section is used for roughing the work down, and the fine section for finishing the pattern accurately to shape. The sanding roll runs at about 1200 to 2400 revolutions per minute, and is from 1 1/4 to 4 inches in diameter.

Making Metal Window Sash

Dies and Methods Employed in Making Window Sash and Casements from T-Section Steel Bars

By ALEXANDER BARTUSCH

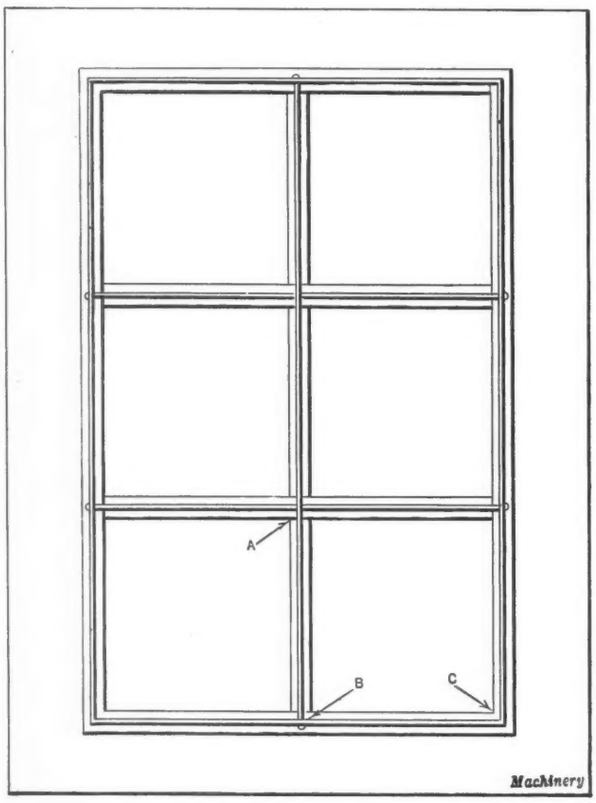


Fig. 1. Steel Window Sash for Factory Building

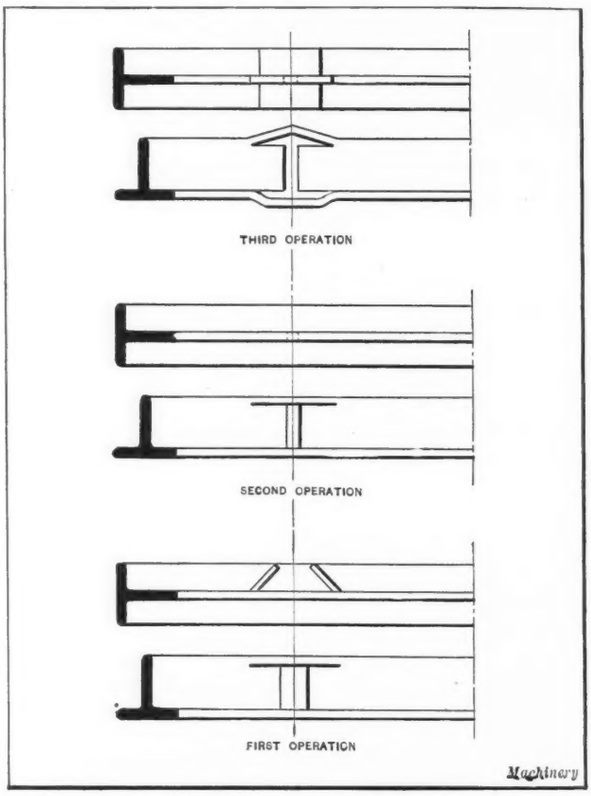


Fig. 2. Die Operations in forming Joint in Window Sash

AT one time the use of metal sash and casements was confined to mansions. Today it is used for all classes of buildings, and can be obtained in designs that harmonize with any style of architecture. The cost is no longer prohibitive, and there are no restrictions as to size and design. In fact, metal window sash is now used in practically all modern buildings, and is an article of commerce that is not dependent upon the skill or training of workmen for quality or quantity.

One of the desirable features of steel window sash is that it can be readily adapted to any type of building construction and to any size and shape of opening. Its appearance, from an artistic point of view, and its durability are factors that have greatly increased its use. In order to meet manufacturing requirements, special machines or methods are employed in making window sash. The dies that punch out the bars to the required shape for use in making the frames, as described in the following, should be of interest to all toolmakers and designers.

A simple factory window sash constructed from T-shaped steel bars, with all the joints cut and formed by punch press dies, is shown in Fig. 1. The joints at *A*, *B*, and *C* are shown in the enlarged views in Fig. 3. The various die operations required in cutting the T-stock for forming joint *A*, Figs. 1 and 3, are indicated in Fig. 2. The die used for the operations indicated in Fig. 2 is shown in Fig. 4. The punch-holder and the die base are both made from steel castings, and the die and punch are kept in alignment by two studs.

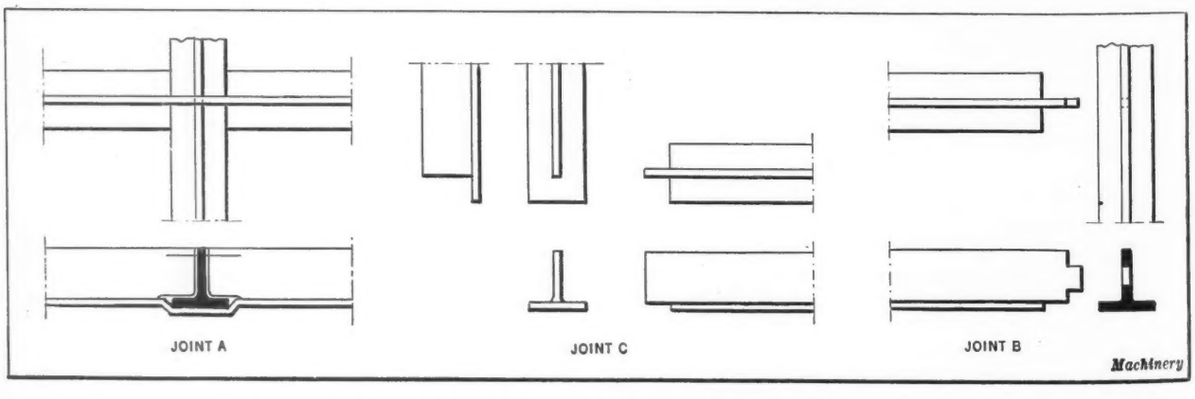


Fig. 3. Details of Joints of Steel Window Sash shown in Fig. 1

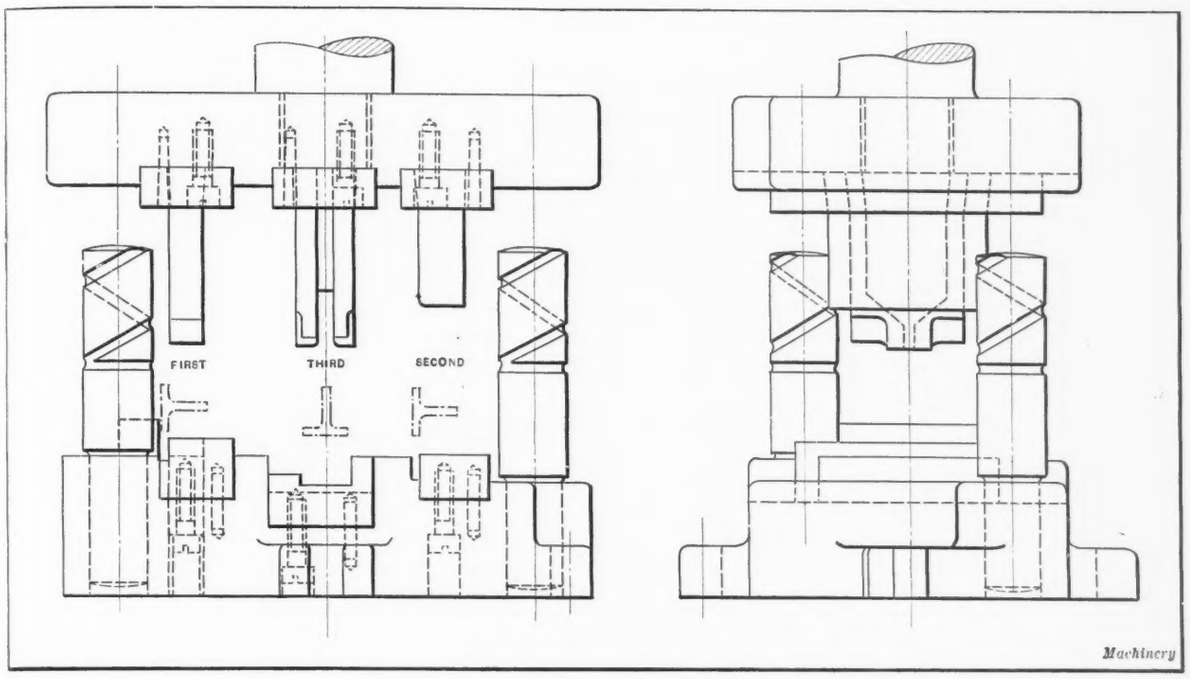


Fig. 4. Die used in performing Operations shown in Fig. 2

The first operation, Fig. 2, is to cut a small slot in the T-shaped bar, and bend the laps out. This is done by the punch and die at the extreme left-hand side of the holder, as shown in Fig. 4. The second operation consists of straightening the bent laps, and is performed by the flattening die at the extreme right-hand side of the holder in Fig. 4. The third operation is crimping the flange of the stock to receive the cross-bar flange. This is performed by the punch and die at the center of the holder. The shortening of the bar by this operation causes the web to be forced out, as shown in the view illustrating the third operation, Fig. 2. The cross-piece is slotted to receive this strip, which is closed in to complete the joint, as shown at *A*, Fig. 3.

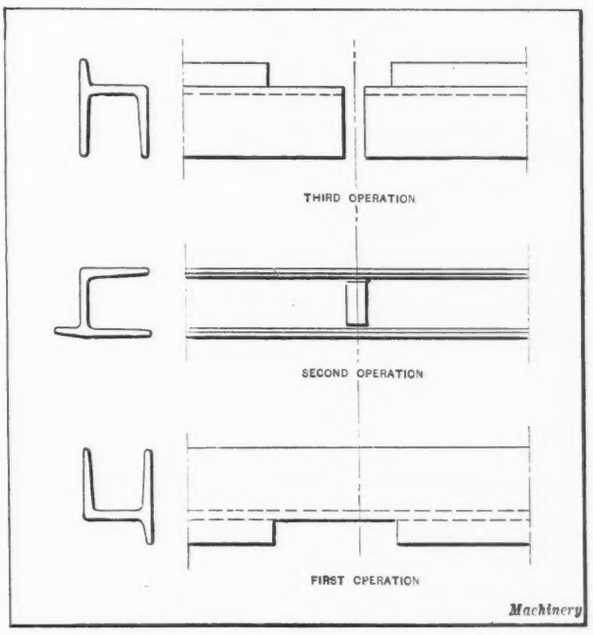


Fig. 5. Operations on Steel Bar Stock used for Window Casings

The die shown in Fig. 6 is used for cutting a U-shaped beam, as indicated in Fig. 5. The punch-holder and the die base are made from steel castings. The first operation consists of cutting part of the beam away, as indicated in Fig. 5. The punches and dies for performing the first, second, and third operations indicated in Fig. 5, can be readily identified in Fig. 6 by the markings. The second operation is that of cutting a slot in the beam, and the third operation consists of cutting the beam into two parts. The ends of the pieces thus cut and formed are placed together at right angles and joined by electric welding. When the metal parts and fittings are assembled, the rust and scale is re-

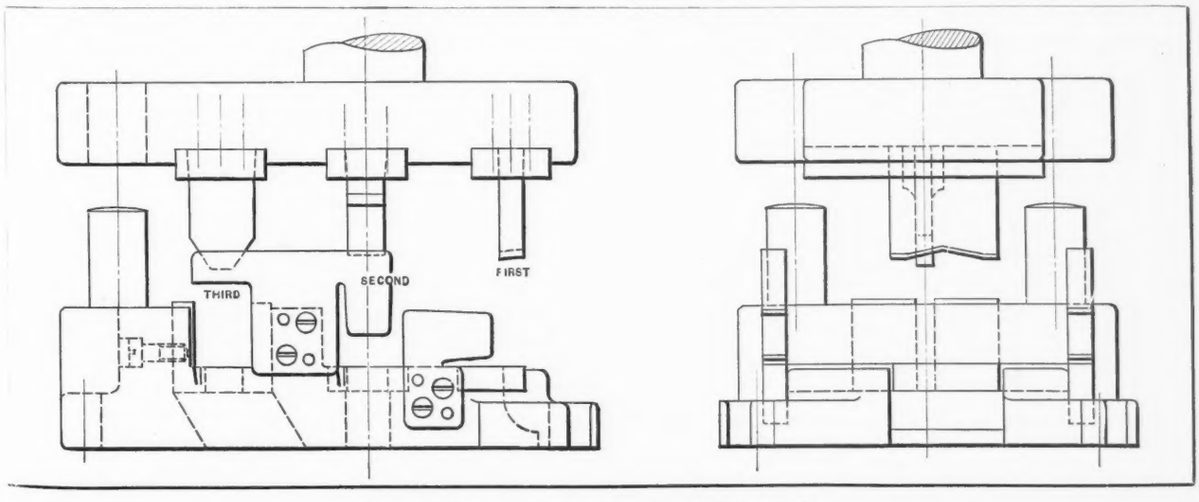


Fig. 6. Die for performing Operations indicated in Fig. 5

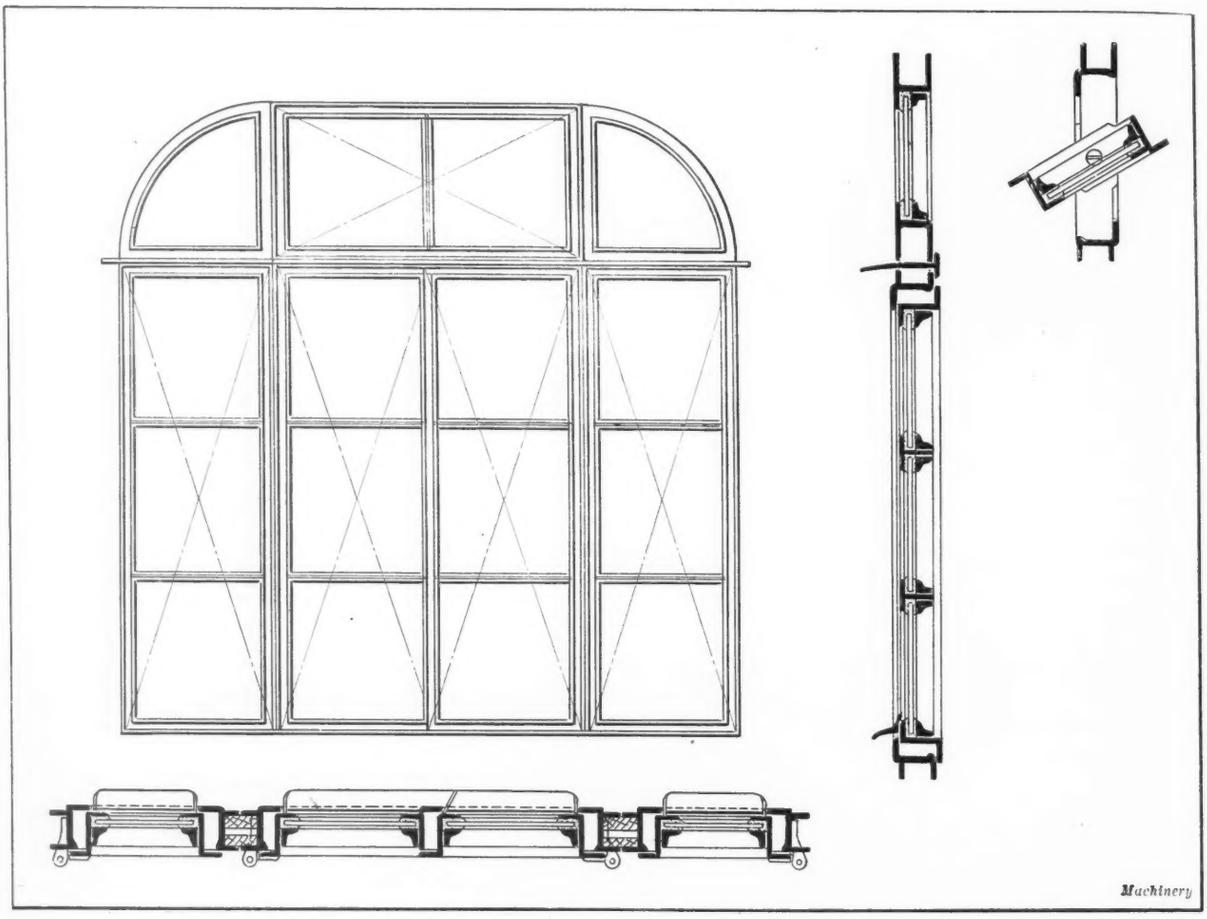


Fig. 7. Sash and Casement made entirely from Steel Bars

moved by sandblasting. The assembly is then dipped in zinc oxide. In Fig. 7 is shown a window sash and casement made entirely from steel bars.

* * *

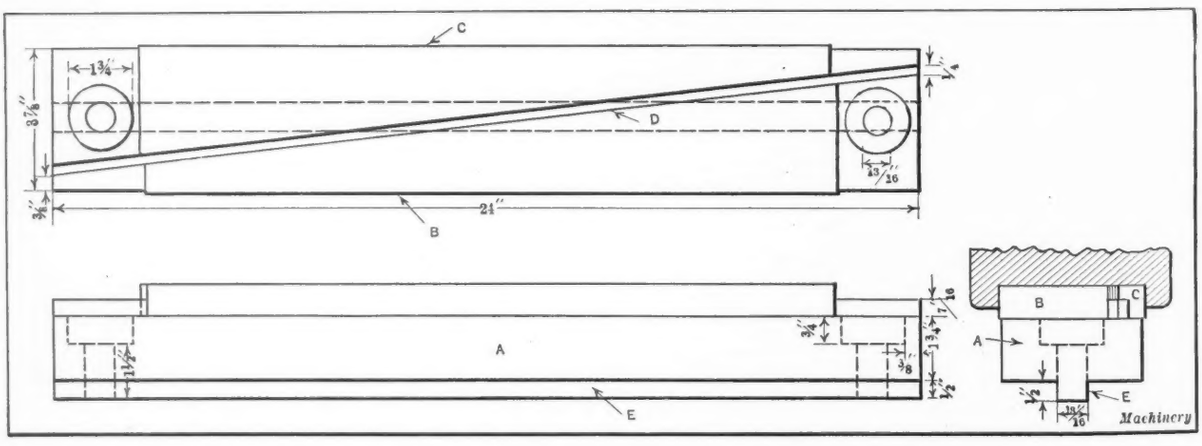
HOLDING ROCKER BOXES FOR BORING

By J. R. PHELPS, San Bernardino Shops,
Atchison, Topeka & Santa Fe Railway Co.

A common design of rocker box or bearing for holding the rocker arm of a locomotive valve gear is bolted to the frame so that the rocker arm bearing is at right angles to the frame. Hence, it is important to have that part of a rocker box which fits over the frame square with the boring machine spindle when boring the rocker arm bearing. The adjustable block or parallel shown in the accompanying illustration is used for this purpose. On the main block *A* there are two tapering parts *B* and *C*. The frame fit on the rocker box is placed over these wedge-shaped members, as indicated by the end view, and *B* and *C* are adjusted endwise to eliminate all play. These tapering strips *B* and *C* bear against a tongue *D*, which is part of the main block *A*; consequently, the outer edges of *B* and *C* always remain parallel to the tongue *E* on the lower side of block *A*, which engages the slot in the machine table. The adjustable feature makes it possible to use the block for frame fits of different sizes. This adjustable block was designed and made by J. H. Lyddon, assistant machine foreman at the San Bernardino Shops of the Atchison, Topeka & Santa Fé Railway Co.

* * *

In 1925, the United States exported motorcycles to a value of $5,075,139, as compared with $4,006,408 in 1924. The United States is second only to Great Britain in the production of motorcycles.



Adjustable Parallel for holding Rocker Box so that Bearing will be at Right Angles to the Frame Fit

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, July 19

THE metal-working industry as a whole is struggling along hopefully, and there is a good deal of optimism as to the probable course of business when some settlement has been reached in the coal lock-out. After nine weeks of idleness in the coal pits, the slight change in the life of the community is surprising. Some weeks ago, it was thought that a universal and severe rationing of electricity supplies to industrial concerns would be imperative, but there are still several areas where no restrictions have yet been imposed.

The railways have shown a tendency to increase service and general facilities for transport during the last two weeks. The railways held large stocks of coal at the beginning of the strike, and with recourse to a certain amount of oil firing and the importation of coal, it is expected that the present 50 per cent services for freight and passengers can be maintained for many weeks if necessary.

The production of pig iron and raw steel practically ceased during the first week of the strike, but stocks have enabled rolling mills in some centers to continue on a substantial basis. In this way, it has been possible to export fairly large tonnages of finished iron and steel. Sections, wire, and wire rope are also still being produced for overseas markets, although the necessary material stocks are now nearly exhausted.

Foundries in some areas in the north of England are fairly active, and have been able to use blast furnace coke stocks for which there is no demand for smelting purposes. Engineering works generally are able to carry on, in some instances, surprisingly well.

The falling away of practical sympathy with the miners on the part of other trade unions is a strong incitement to settlement, particularly as many of the unions are experiencing a rapid increase in unemployment among their members as a result of the inactivity in the coal mines. In some quarters it is felt that a reopening of negotiations on the basis of the Coal Commission Report might even now result in an amicable issue. In the meantime, a vital industry that has not been paying its way has shut down, with the result that this country's markets for coal are being supplied from elsewhere, and at the best, it will be a long time before these can be regained.

Inquiry Being Maintained in the Machine Tool Industry

In the machine tool field, a very encouraging sign is the maintenance of inquiry, and although a negligible number of orders are being placed, an increase in business is expected to synchronize with any settlement of the mining trouble. Developments in railway shops, particularly abroad, are helping to keep makers of the necessary machine tools and other equipment moving. Makers of surface grinding machines and gear-cutting machines are also among those who appear to have enough work in hand to keep them busy for some time.

Exports and Imports of Machine Tools Show Decline

The overseas trade in machine tools during May showed a decided drop in both exports and imports. The following figures show the returns:

	March	April	May
Exports, tons	1302	1213	917
Imports, tons	901	511	473
Exports, value	£145,054	£128,347	£97,735
Imports, value	£98,039	£78,053	£57,386
Exports, ton value	£111	£106	£107
Imports, ton value	£109	£153	£121

The falling off during May was less for machine tools than for trade generally, although a sequence of three months of shrinking exports of machine tools neutralizes the general upward tendency of the last twelve months. The value per ton of imported machine tools is now only 26 per cent above that of pre-war values, and indicates an increased dumping of cheap machines. Lathes have figured prominently of late among the cheaper imported machines.

The Automobile Industry Has Set-back

During the last two months, the automobile industry has experienced its first real set-back, and the comparative slackness, which is felt to be due entirely to the coal strike, and therefore only temporary, has reacted unfavorably on foundries, gear-cutting firms, and other lines of which the automobile industry is the backbone.

A recent event of considerable importance has been the registration as a public company of Morris Motors (1926) Ltd., which acquires and is to carry on the business of Morris Motors Ltd., Morris Engines (Coventry) Ltd., and other subsidiary companies. The nominal capital is £5,000,000. For the year ended last August, the Morris Co. sold 42,750 cars, and the big capital mentioned represents the building up of the business out of profits, as the original cash capital was only £45,000.

Conditions in General Engineering Field

In the general engineering field, home orders are very scarce, but as a whole, there is a fair amount of work in hand for export. There is increasing difficulty in obtaining materials, however, and firms using coal for fuel are reluctant to pay the heavy prices asked for the inferior coal coming from the Continent. Such coal is quite useless for the steel trades, in which there is an almost complete stoppage in production. There will be plenty of work available for railway material makers when the coal trouble ends.

Among the engineering branches that appear to be fairly well off for immediate work, are crane makers and textile machinery makers. Electrical engineering firms have generally done better during the first six months of this year than they did in 1925, and very busy times are expected in all sections of the industry when the labor horizon clears.

* * *

DEVELOPING MACHINERY MARKETS ABROAD

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., has just issued a booklet entitled "Developing Machinery Markets Abroad." The booklet has been prepared with a view to assisting manufacturers of machinery in developing export trade and indicates, in a general way, the methods that have been successfully used heretofore in distributing American machinery throughout the world. Manufacturers are advised that the Bureau of Foreign and Domestic Commerce is prepared to cooperate with them in the solution of any export problems that may come up, and that the bureau maintains a corps of experts qualified for this work.

The booklet referred to covers such subjects as the selection of a distributor abroad, the placing of a salesman in the foreign office of the representative, foreign dealers as representatives, cost of living abroad, cost of opening a branch office, home organization, supervision of the export department, relation of the export department to the representatives, export policy in times of depression, direct trade, terms of payment for exported machinery, results of overstocking dealers, and routine of the home office.

Current Editorial Comment

in the Machine-building and Kindred Industries

OUR NEED FOR SCIENTIFIC RESEARCH

Men with broad vision who, like Secretary Hoover, see the future as well as the present needs of industry, claim that we are neglecting scientific research in this country, and that in future our industries will suffer because of neglect of the non-commercial laboratories. A movement has therefore been started, in which Secretary Hoover is deeply interested, to secure pledges by industrial enterprises and by men interested in industrial development, of $20,000,000 to be expended on purely scientific research during a period of years. Of this sum $3,000,000 has already been pledged.

Managers of industrial works often are likely to take for granted the past developments of science, and to apply the results without a thought of the part played in industrial development by scientific researchers in modest laboratories connected with institutions of learning. Practical men are likely to believe that such research is of no direct value to industry, because it cannot be commercialized immediately. A prominent steel manufacturer recently stated that all the advance in the steel industry resulted from the work of practical metallurgists employed in the laboratories of the steel companies. He overlooked the fact that all the metals now used in alloy steels to impart to steel properties believed to be impossible only twenty-five years ago, were the discoveries of scientific research men. In almost every case it is the scientific laboratory that establishes the foundation of knowledge upon which later the applied science laboratories of industry are able to build a commercial structure.

When the Nobel Prize was awarded for the discovery of wireless telegraphy, it was divided between Marconi and an obscure professor at a German university whose name was unknown to everyone except a few scientists. Yet this man was recognized as equally important in the development of wireless communication, because upon the foundation of the scientific researches of Professor Braun, Marconi erected a new and practical means of communication that at first seemed like a page from a fairy tale.

It is because of the great importance of scientific investigation, apart from its practical industrial application, that so practical a man as Secretary Hoover strongly advocates the establishment of a fund for purely scientific research as a basis for our future industrial development. Unless the scientist constantly blazes new trails which the practical engineer can follow in building the roads of progress, our industrial advance will gradually slow up.

* * *

THE HIGH COST OF CHIPS

How many tool designers have considered that sometimes it takes the operator using a jig or fixture longer to brush out the chips from the cavities of the fixture than to remove the work and clamp a new piece? When the operator attends to a number of machines, so that his time is wholly occupied in removing work from and replacing it in the machines, the labor cost is sometimes doubled by the time required to brush out chips from the fixtures. It is therefore important that jigs and fixtures be so designed that, as far as possible, they "shed" the chips produced by the cutting operations and that there be no cavities where chips can easily lodge and from which they must be removed by brushing or otherwise, if the fixture is to be continuously and economically used.

When production engineers consider that sometimes as much as one-half the operator's time, and therefore as much as one-half the labor cost per piece machined, is spent in brushing away chips, because jigs and fixtures are not properly designed to prevent their accumulation, more attention will be given to this feature of tool design, and another cause of waste in time and effort will be eliminated. This will give the operator more time to load and unload, and he can, of course, handle a larger number of machines than would otherwise be possible, without any greater exertion or fatigue.

* * *

INCOMPLETE INQUIRIES WASTE TIME

A well-known tool manufacturer recently stated that fully 20 per cent of the time of his engineering estimating department was wasted because of the incompleteness of the information sent by prospective buyers. Frequently a number of letters had to pass back and forth before sufficient accurate information was obtained to enable the estimating department to go ahead with its work and furnish a correct quotation.

Attempts to express too briefly in a letter the needs of a customer often result in ambiguous statements, or in incomplete data that cause delays, telegrams and additional correspondence. Sometimes blueprints are not properly dimensioned, or do not contain sufficient dimensions for the engineering department to work from; or there are too many dimensions, some being contradictory. Greater care should be given to the dimensioning of drawings to make sure that every essential dimension is given, and that in no case are two dimensions given which do not accurately check with each other.

The greatest difficulty with drawings is caused by the tolerances given. Sometimes tolerances are omitted altogether, giving the tool manufacturer no idea of the accuracy required. Again, tolerances may be given on every dimension and in such a way that it is impossible to adhere to all of them without producing a tool altogether too expensive for commercial purposes.

Buyers can save themselves time and money, and also greatly simplify the work of the tool manufacturer, if they will give complete and explicit information with the first inquiry, and make sure that all the drawings they furnish are carefully dimensioned. The accuracy indicated by the tolerances on the drawing should not be greater than actually needed for the purpose of the tool or machine, because unnecessary accuracy means added expense, with no gain in quality.

* * *

FIND OUT WHY REPAIRS ARE NEEDED

Some machines require frequent repairs. A certain part breaks and is replaced; it breaks again, and may be replaced a number of times. When the first break occurs the cause should be found and necessary precautions may avert a second. Repeated breakages of the same part indicate that the design is faulty, and that instead of merely replacing the broken part the design should be improved.

Many mechanics think that their duty is done when a broken part has been repaired or replaced, but it is more important to find out the cause of the break and prevent repeated shutting down of the machine for repairs. Superintendents should require a report in connection with every repair made to the mechanical equipment, stating the probable cause of the trouble. If these reports are intelligently acted on, a great deal of waste time due to shutdowns for repairs can be avoided and the cost of labor and material for repairs can be greatly reduced.

Accurate Gaging of Tapers

Gages Used for Checking Taper Parts Made to a Basic Diameter on which no Tolerance is Specified

By A. J. CAYOUETTE, Chief Gage Designer, White Motor Co., Cleveland, Ohio

So many varying methods are used in dimensioning taper parts that the result has been confusion in the minds of a vast majority of mechanical draftsmen, toolmakers, and machinists. We often find one part dimensioned with maximum and minimum limits at both the large and small ends, and, perhaps, with a fractional linear dimension between them. Also, the mating parts may be dimensioned at either the large or the small end, with nothing but the mechanic's intuition and the grace of Providence to insure that the mating parts will have the desired fit when they are assembled.

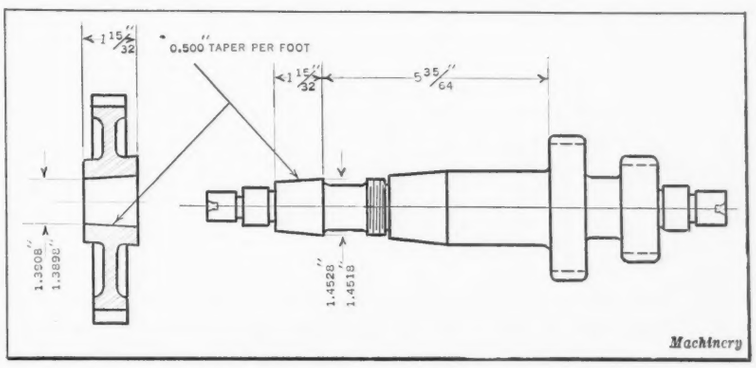


Fig. 1. Unsatisfactory Method of specifying Dimensions of Taper Parts

Many hours are wasted in the shop trying to produce the required taper to dimensions given as illustrated in Fig. 1, but more time is wasted in the tool and gage design departments trying to determine the taper fit intended. As the angle of taper is not a variable, the question naturally arises as to which of the limits should be used. It is evident that the solution of such a problem is impossible, on account of the combined and contradictory tolerances. The fact that parts dimensioned in this manner are being produced proves nothing, because thorough investigations disclose the fact that the parts are either produced to dimensions established by cut-and-try methods or to gages made to suit experimental taper parts made by cut-and-try methods.

An ideal method of dimensioning tapers was explained in the article entitled "Accuracy Control in Interchangeable Manufacture," published in May MACHINERY. When that method is employed, the problem of making gages to insure the proper assembly of taper parts becomes a very simple one. Examples of gages designed for checking parts produced according to drawings dimensioned by this method will be given in the following.

Various Types of Taper Gages

Taper gages are shown in Fig. 2 for the parts illustrated in Fig. 6 of the article referred to. For the taper of the shaft, there is a taper ring as shown at *X*, having the flat basic dimension 1.452 inches marked on the face adjacent to the large end of the taper hole, and also a "Go" and "No Go" length gage for determining the location of that face of the ring gage from the face of the gear which is integral with the shaft. The "Go" dimension of the length gage is the minimum dimension 5.804 inches specified on the work, and the "No Go" dimension is the maximum dimension, 5.828 inches.

The gage for the taper hole in the gear consists of a taper plug equipped, as shown at *Y*, with a flush pin in the flange for determining the location of the basic diameter of the hole in relation to one face of the gear. By comparing the limits specified on the gear and the gage, it will be found that when the pin is flush with step *A* of the gage, the basic diameter 1.452 inches is the minimum distance 0.234 inch from the face of the gear. When the pin is flush with step *B*, the basic diameter is the maximum distance 0.258 inch from the face of the gear.

In Fig. 3 are shown gages for the parts illustrated in Fig. 4 of the article in May MACHINERY. The gage shown at *X*, for the taper of the shaft, is a ring gage similar to the one shown in Fig. 2, except that a flush pin is incorporated in the gage. This flush pin is used to determine the location of the flat basic diameter 0.750 inch, instead of a separate length gage. The gage for the taper hole of the gear may be a flush-pin taper-plug type, similar to the gage shown at *Y*, Fig. 3, or a step-type taper-plug gage having the step at the large end, as shown at *Z*. Economy may be attained in the flush-pin type by so making the gage that the basic diameter is located about 1/4 inch from the face of the collar on the gage. This will permit renewing the gage to the proper size as it becomes worn. The step type gage cannot be salvaged in this manner.

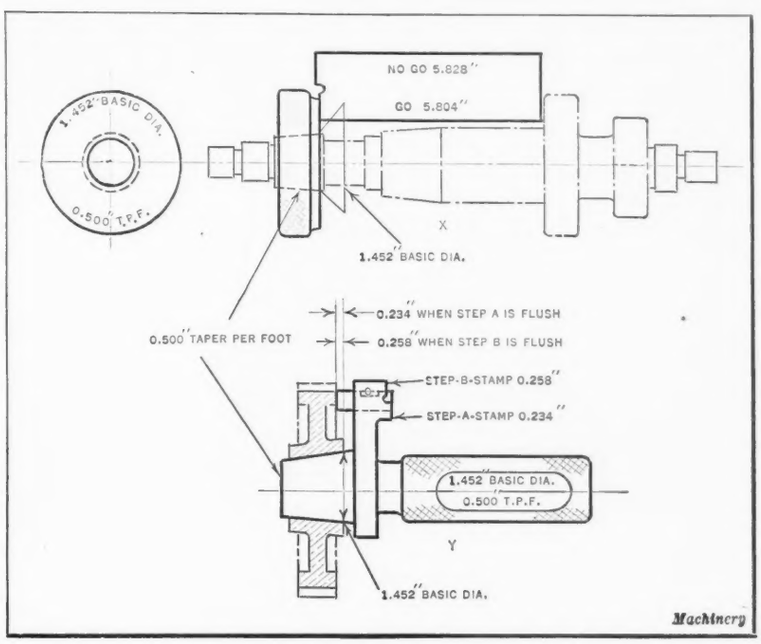


Fig. 2. Gages used in the Inspection of Taper Parts

Gages for checking the parts illustrated in Fig. 5 of the previous article are shown in Fig. 4 of the present article. The gage for the taper of the shaft consists of the taper ring at *Y*, which has steps on the face of the small end. These steps are ground in relation to the basic diameter, 1.219 inches. When step *A* is flush with the small end of the taper portion, the basic diameter is 1.469 inches from that end, but when step *B* is flush, the basic diameter is 1.438 inches from the same end.

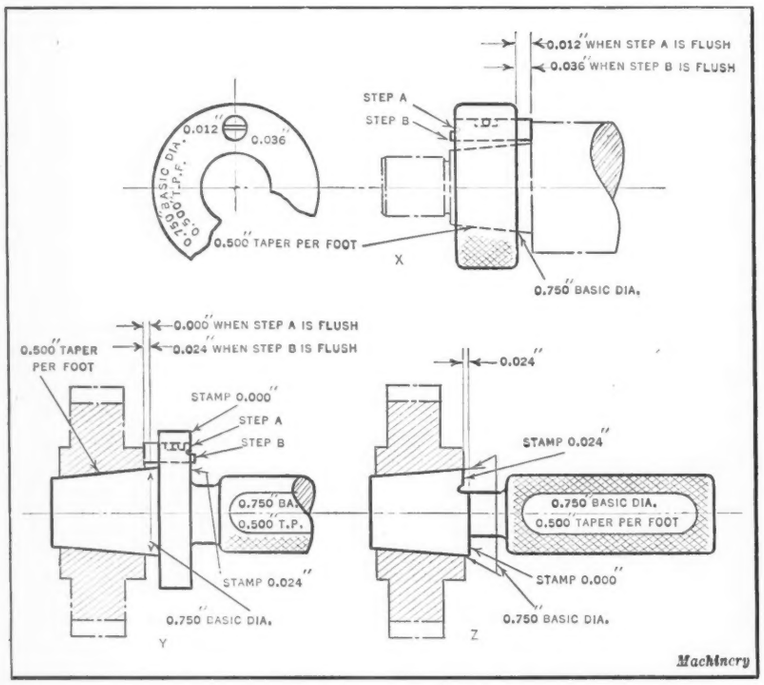


Fig. 3. Taper Gages of the Flush-pin and Step Types

The gage for measuring the hole of the mating part consists of a taper plug having steps on the face adjacent to the small end. These steps are also ground in relation to the basic diameter 1.219 inches, and so when step *A* is flush with the face of the work, the basic diameter is at the maximum limit of 1.156 inches from the same face. When step *B* is flush with the face of the work, the basic diameter is at the minimum limit of 1.125 inches from that face.

Stamping, Dimensioning, and Checking Taper Gages

Attention is called to the necessity of having an intelligible system of stamping pertinent information on gages. Unless the workman or inspector can identify the gage with the dimensions on the corresponding work drawing, too much must be taken for granted. If, however, important drawing dimensions are repeated on the gage, no room remains for doubt, and the user can proceed with a greater degree of confidence. The nature of the information stamped on the gages here described may be seen in the various illustrations.

To insure accuracy in the interchangeable manufacture of taper parts, a set of master taper plugs of the type shown at *X* in Fig. 5 is essential. By lapping with the bluing method, the taper of a ring gage can be made to conform to the taper of such a master plug, and by the same method, the taper of a plug gage can be made to conform to the taper of the ring gage that conforms to the master taper plug.

The taper of a plug gage can be conveniently compared with a master taper plug by means of the machine illustrated in Fig. 3 of the article in May MACHINERY. The length of the taper portion of each master plug should be approximately 8 inches. The taper of such plugs may be checked by the method illustrated at *Y* in Fig. 5. By using accurate rolls and gage-blocks, two measurements may be taken 6 inches apart, and the difference in the two dimensions multiplied by 2 to obtain the taper per foot.

The use of a master taper plug facilitates the dimensioning, making, and inspecting of taper ring gages. From Fig. 6 it will be seen how taper ring gages may be dimensioned from and measured by a master taper plug. The basic hole diameter at the face of the ring gage that may be seen at *W* is easily obtained within close limits by measuring from this face to the large end of the master plug, and grinding off the face of the ring to the tolerance specified. In this connection, it will be noted that as the taper per foot is 0.500 inch (24 to 1), a linear tolerance varies twenty four times as fast as a diametral tolerance. For instance, 4.459 inches minus 4.454 inches equals a tolerance of 0.005 inch on the length. This tolerance is equivalent to a tolerance of approximately 0.0002 inch on the basic diameter.

At *X* in Fig. 6 is shown how the flush-pin type of taper ring gage illustrated at *X* in Fig. 3 is dimensioned and measured in relation to a master taper plug. In this case, the end of the flush pin is ground within the specified tolerance between it and the large end of the master taper plug, thus making it unnecessary to maintain close accuracy on the large diameter of the taper hole in the ring gage, and also minimizing the accumulation of tolerances.

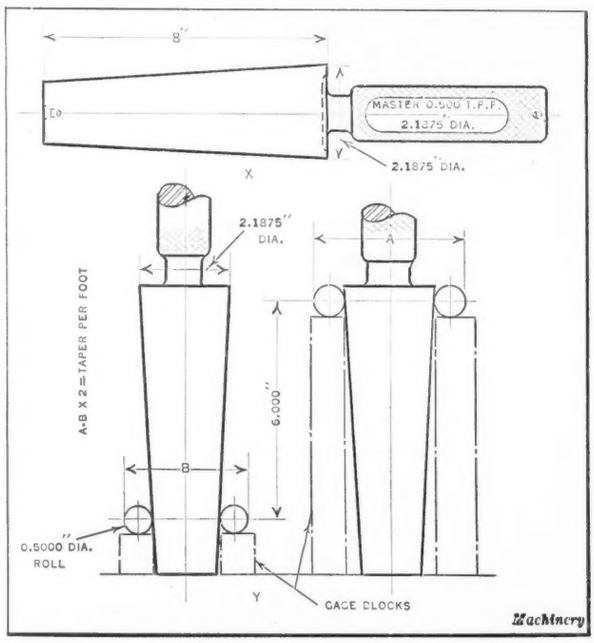


Fig. 5. Master Taper Plug and Method of checking it for Accuracy of Taper

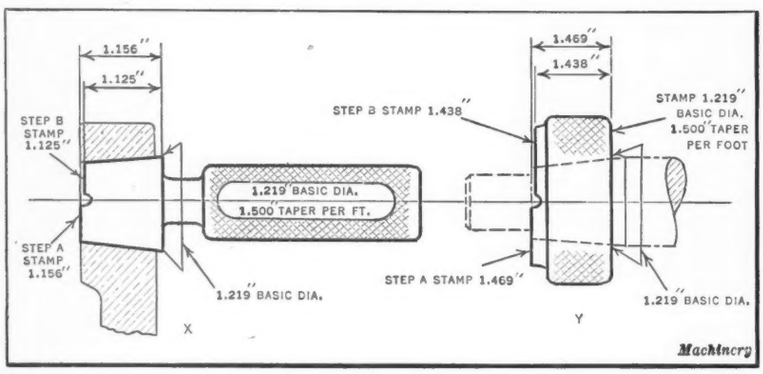


Fig. 4. Ring and Plug Step Type Taper Gages

Illustration *Y* in Fig. 6 shows how the step type of taper ring gage shown at *Y*, Fig. 4, is dimensioned and measured. The steps are measured from the face of the large diameter of the master plug, making it also unnecessary to maintain a high degree of accuracy on the basic diameter of the large end of the hole in the taper ring gage.

Taper plug gages of the flush-pin or step types illustrated in Figs. 2 and 3 may be dimensioned and measured by the wire method

shown at *W* and *X* in Fig. 7. The step type may also be dimensioned and measured at the large end of the taper, provided the edge is not broken or rounded. However, the ideal method for either of these two types is to use a checking ring, as shown at *Y* and *Z*, respectively. With this method, the taper angle and the basic diameter can be checked without requiring as much skill or time as is needed for other methods.

* * *

PRESENT STATUS OF AERIAL TRANSPORTATION

In a paper recently read before the Junior Institution of Engineers in Great Britain, by the Air Vice-marshall Sir Sefton Brancker, a general review of the present status of air transportation in Europe was given. In view of the growing interest in air transportation and the increasing importance of the aircraft industry in this country, a brief review of this paper will prove of interest.

British planes have carried more than 70,000 passengers across the Channel, and have flown, a total of 4,750,000 miles in commercial service. A regular service is maintained between London and Paris, and between London and Amsterdam, at the latter point connecting with a Swedish line to Malmo and a German line to Berlin. Another regular service is also maintained to Cologne, connecting with a German line to Munich. The line to Paris connects there with lines to Basel and Zurich. France maintains regular services to London, Amsterdam, Constantinople, and Warsaw. The total mileage flown by French commercial planes in 1925 was nearly 3,000,000 miles, and up to the end of 1925, French commercial planes had covered 11,250,000 miles. Germany has lines radiating to Amsterdam, Finland, and Moscow. Holland, Belgium, and Sweden are also maintaining regular commercial air lines. Altogether, nearly 15,000,000 miles were covered last year in European flights over regular air routes totaling 31,000 miles in length.

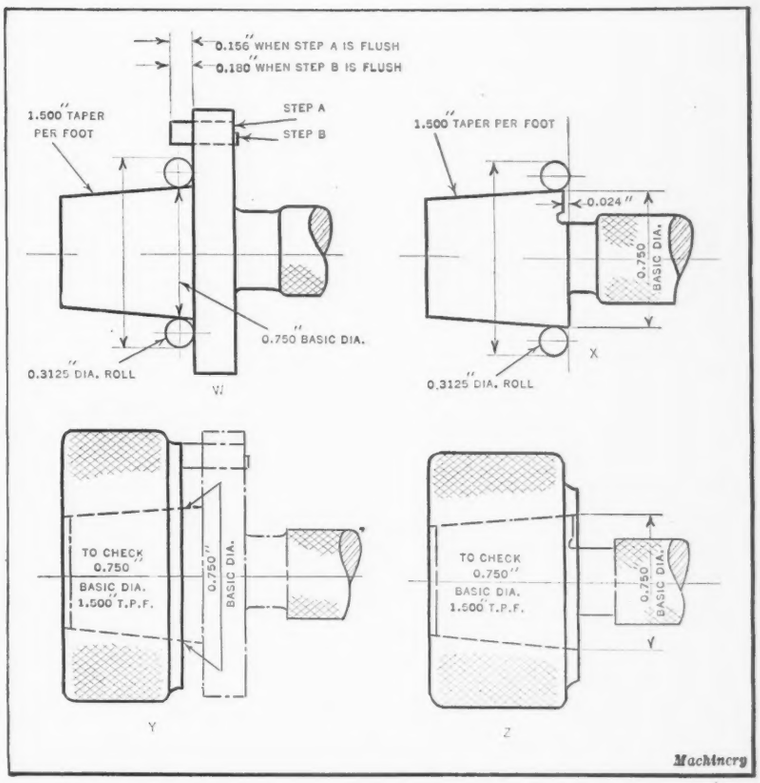


Fig. 7. Two Methods of dimensioning and checking Flush-pin and Step Type Taper Gages

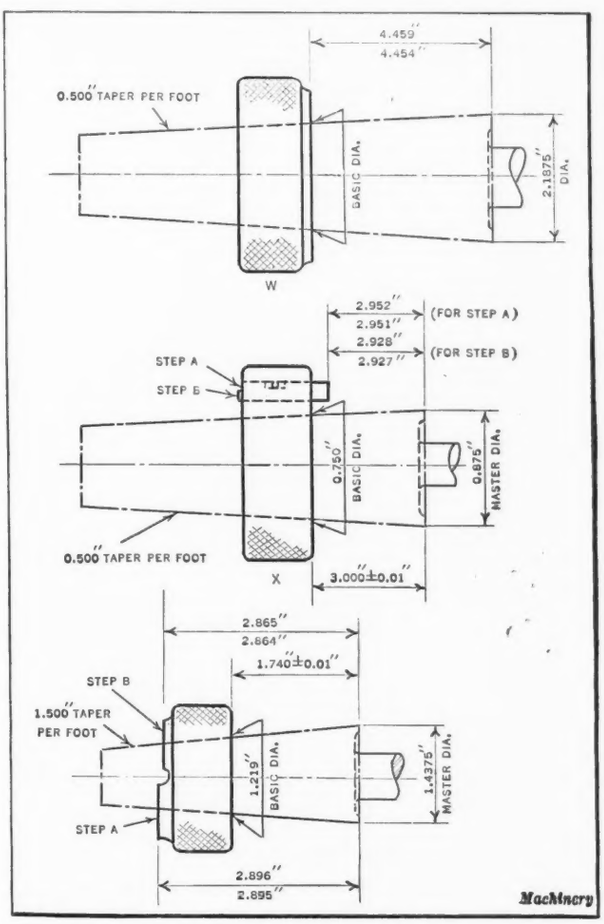


Fig. 6. Methods of dimensioning and checking Taper Ring Gages from a Master Taper Plug

It is of especial interest to note that practically all of these services are run at a loss, as they are all maintained by the aid of government subsidies. England pays, for this purpose, about $650,000 annually; France, 57,210,000 francs; and Germany, $1,700,000. As it is evident that such subsidies cannot be continued indefinitely, the future of commercial air transportation in Europe is clearly bound up in the possibility of reducing operating costs until an economic level is reached.

According to the paper quoted, the present cost of transportation by air in Europe is $1.20 per ton-mile at 90 miles per hour. Such a charge, it was stated, is very high, but not impossible for passenger traffic to assume, and can be accepted as a satisfactory rate for first-class mail matter carried at high speed.

A machine ought to be able to spend 2000 hours a year in the air, but so far, 1000 hours a year has been considered good for planes at present used in Europe. Depreciation of planes must be figured as at least 20 per cent per year, but even this depreciation does not cover the constant improvements in design that are being made. It is believed that if money were available for this purpose, most of the existing machines that are now used in European aerial transportation would be replaced by all-metal aircraft fitted with air-cooled engines.

Sir Sefton Brancker pointed out that future developments would probably be in the direction of an all-metal, thick-wing airplane, without flying wires or struts. The maintenance cost of such planes should be very low, because even biplanes, as now constructed, of wood and fabric with interplane struts and wires, have flown, in the British climate with good housing and care, for eighteen months without overhauling, totaling 2000 hours in the air and covering 170,000 miles in that period. Metal planes ought to be able to make an even more remarkable record, and figures on such planes, when available, will prove of great interest.

Reducing Costs By Improving Design

By ANDREW ATKINS

THE design of an article determines, largely, the production cost. Therefore, a designer should be sufficiently familiar with modern production methods to decide whether the work will be expensive to produce or not; if it is expensive, suitable modifications should be made in the design so that the part can be machined at the least possible cost. In recent years, designers have been studying more carefully the intimate details that affect manufacturing, but many of the products that have been on the market for some years and that were designed when labor costs were much less than at present, require an excessive amount of machining, and therefore cost much more than they should.

The writer has recently seen a number of examples of a product of expensive design which has been made for over twenty years; during this time, it was redesigned once with the idea of improving it, but the cost of production was materially increased in the process. Suggestions for cheapening the design did not meet with the approval of the management, and attempts are being made to lower production costs by installing piecework methods in the shop and thus get higher production for less money.

Conditions such as this are found in many of the older factories; the management hesitates to change a design or modify it, for fear that the customers may get the idea that the product has deteriorated in value. In point of fact, many old designs of inherent worth could be materially improved and their cost reduced by a careful study of some of the newer processes in use in modern factories.

The use of drop-forgings instead of castings, cold drop-forging of brass shapes, pressed steel, stamped or drawn brass work, die-casting, etc., all help greatly in reducing costs, and at the same time give better quality and often additional strength. However, the design must be changed to suit the different methods of production, and new tools must be made in many cases, which, of course, increases the initial cost. When production is comparatively small, it is more difficult to make the changes than when a number of new tools are required, but even in such cases, it is usually safe to assume that if a certain product has been in continuous demand for a certain number of years, there are not likely to be any radical changes, and therefore any cost cutting improvements will pay for themselves. It is comparatively easy to make a cost analysis of the proposed change and compare it with the present cost of production to determine whether a given change will pay for itself or not. On a standard product, it is usually safe to figure that an improvement will be profitable if the gain in production is sufficient to absorb the cost of new tools or other changes in from one to two years.

Castings Replaced by Stampings

A few simple examples are given here to illustrate the advantages gained by improving the design. In each case shown, the savings were apparent, and the design was not inferior to the previous one; in fact, it was decidedly better in some cases. In Fig. 1 at *A* is shown part of a housing *C* through which an oil-pipe *B* extends. The cover plate *E* is of cast iron, and has a central cored hole *D* in it for the pipe to pass through. The cover plate is drilled and countersunk for two screws *F*. The operations on the cover plate began with surface-grinding the contact face *G*, which was used to locate the work in a jig for drilling the two screw holes. The piece was then rough-filed to remove irregularities at *H*, and finally sand-blasted before enameling. As it was part of a nicely finished product, great care was taken to give it a good appearance. On looking up the cost records, it was found that the pieces cost about 21 cents each, including the casting.

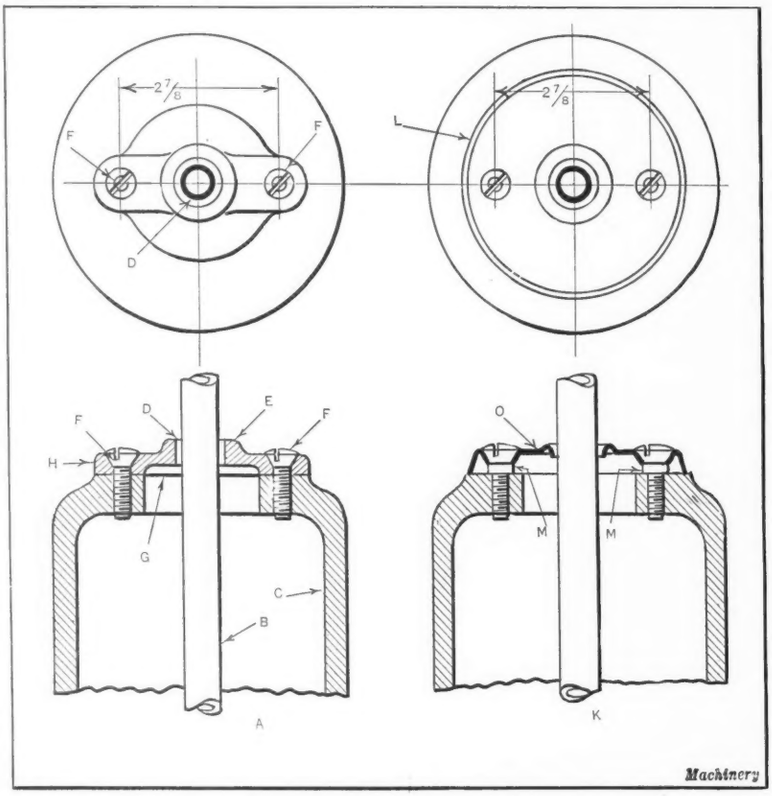


Fig. 1. Use of Sheet-metal Stamping in Place of Casting

In order to reduce the cost, the design was changed as shown at *K*. The finished pad on the housing was made in circular form, as at *L*, and the cover plate was made as shown at *O*, from a steel stamping that required no machining whatever, but was made entirely on a punch press. Two little washers at *M* serve as fillers and prevent distortion when the screws are tightened. The finish of the work is superior to that of the cast-iron piece, and the cost, including material, is only a little over 3 cents each. The dies were simple, so that their cost was absorbed in less than a year.

Another example in which a steel stamping is used to replace a casting is shown in Fig. 2. Here the original piece *A* was first surfaced at *B*, then milled at *C* and *D*, and drilled at *E*. This piece was also filed and sand-blasted after machining and before enameling. The cost, including the casting, was 34 cents each. In redesigning it to cheapen manufacturing costs, it was changed to the form shown at *F*. The lugs *G* and *H* were punched first, then blanked out and turned down as indicated, and the edges *K* were drawn to shape on a punch press. The metal was a little heavier than in the original design and the dies cost a little more, but in spite of that, the cost came to less than 5 cents each, including the material.

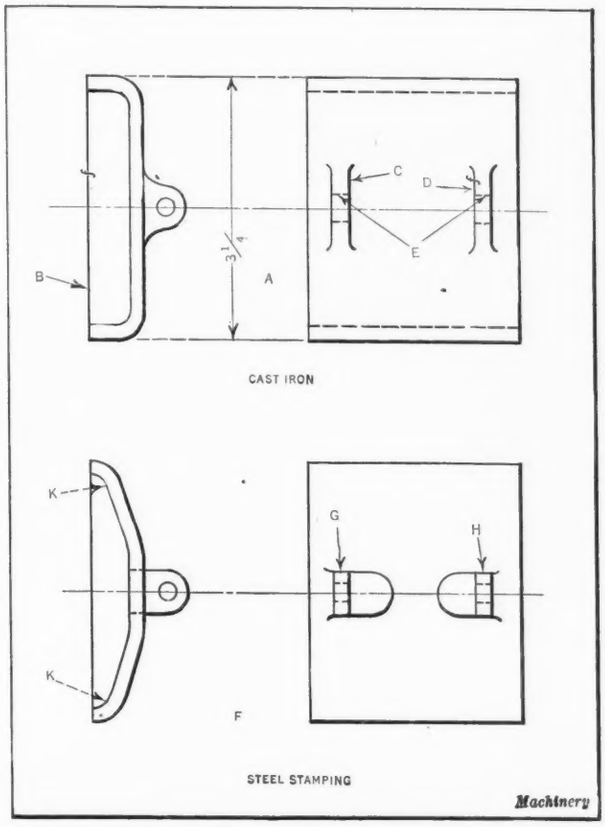


Fig. 2. Another Example of the Use of a Steel Stamping in Place of Cast Iron

These two cases illustrate forcibly the savings that are possible when the nature of the work permits stampings to be used instead of castings. It will be noted that in neither case are there radical changes in design nor is the appearance of the product cheapened in any way.

Influence of Design on Cost of Machining

Too many designers think only of the possibility of machining a certain part without considering difficulty of access or trouble in holding the work. It is not enough to design a piece of work so that it can be machined; the designer must also consider whether the machining can be done with simple tools and standard equipment. Expensive cutterheads, elaborate fixtures, internal milling or drilling attachments, all add materially to the cost of production, and the design should be worked out so as to minimize their use as far as possible.

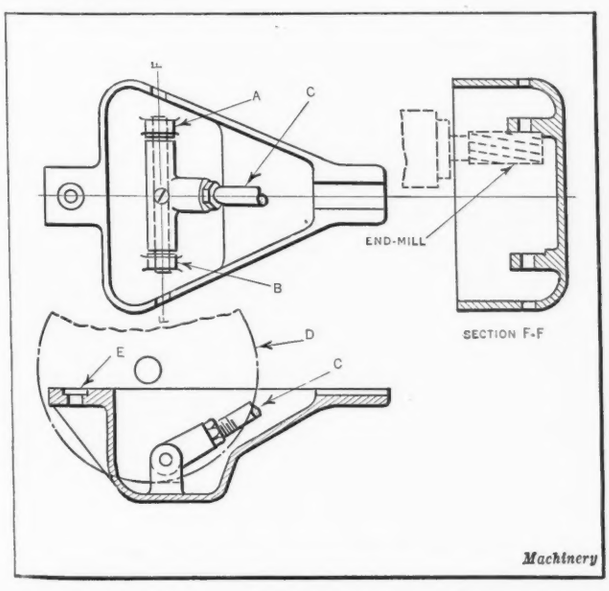


Fig. 3. Example of a Design that involved a Difficult Milling Operation

Another example, shown in Fig. 3, is a part of a cast-iron unit on which several drilling and milling operations must be performed, all of which are comparatively simple, except that of milling between the two lugs *A* and *B*, located at the bottom of the case. The lugs are used for the pivot pin of the rocker lever *C*. The requirements of the design made it necessary for this pivot point to be located very low down, and the designer apparently assumed that the lugs could be milled without difficulty. The dotted lines *D* indicate the size of cutter that would be necessary for the operation, and it is evident that cutters of this size would be out of the question, for they would cut through the end surface, as shown at *E*. The work was eventually machined with an extra long end-mill having spiral flutes designed to cut in the usual way. The operation was done by raising the table to the proper height, and feeding it longitudinally to surface the lug *A*; then by moving the table over the correct distance and reversing the table feed, the lug *B* was milled on the return stroke.

This method was slow and unsatisfactory, and there were many chances of error due to the different table movements

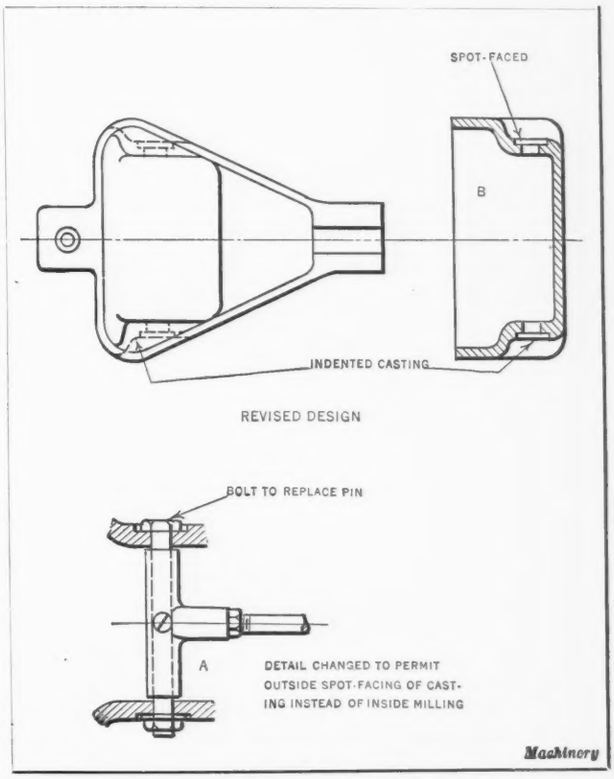


Fig. 4. Revised Design for Part shown in Fig. 3

required. The design could just as well have been made as indicated in Fig. 4, by making a slight change in the construction of the rocker lever, as shown at *A*. By indenting the outer surface of the casting so as to give it the appearance shown in the sectional view *B*, the work could be drilled and spot-faced on the outside, and the milling operation done away with entirely. The change in construction was permissible and did not interfere with the operation of the rocker lever.

Fig. 5 shows details of construction of a unit consisting of a base casting *A* through which a sliding bar *B* is adjustably fastened by a hand-knob *C* and a binder *D*. The requirements of the construction are that the bar must be easily adjustable and firmly locked at any desired point without any chance for looseness or turning around in the socket. The bar is milled to a partial V-section, as shown in the end view *E*, and binder *D* and base casting *A* are broached and milled, respectively, to the form of the vee, thus giving an excellent location and binding adjustment, but one that is very expensive to make.

Fig. 6 shows the revised design, in which the binder is made in the form of a cylindrical plug *A* having a hole

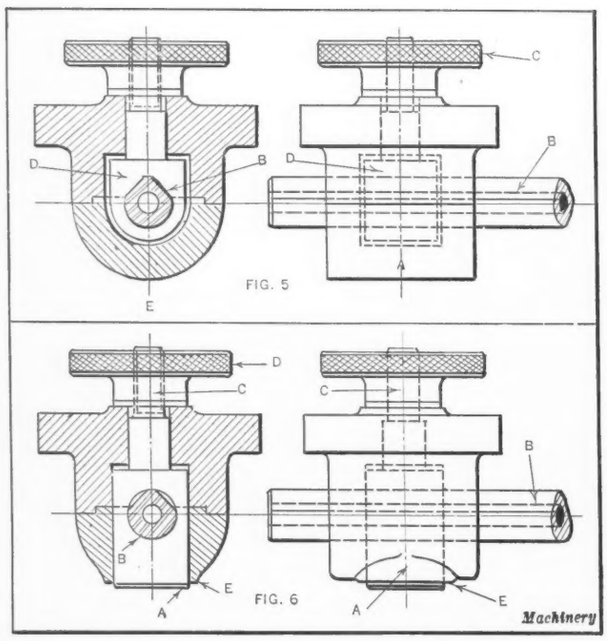


Fig. 5. Piece so designed that the Production Cost was High
Fig. 6. Simplified Design for Piece shown in Fig. 5

through it slightly larger than the bar *B*. The small end of the binder is threaded at *C* for the hand-knob *D*. The large end of the binder protrudes slightly, and is nickel-plated for the sake of appearance. Only a slight change in the body of the casting is necessary, namely, the addition of a boss at *E* and the boring of hole through it. The construction cost is much less than in the previous example, yet both appearance and utility are fully as good as before.

These few examples show how easy it is to effect savings in manufacture by giving more thought to the cost of machining, both when working on a new design and when simplifying an old one.

* * *

GRINDING SMALL INTERNAL SCREW THREADS

By O. S. MARSHALL

In order to salvage some costly parts like the one shown at *A*, Fig. 1, it became necessary to correct the errors in a 3/4 by 20 internal thread, which had become badly distorted during the hardening process. This was accomplished by grinding the thread. In Fig. 2 is shown the method used to form the grinding wheel that was employed in correcting the thread.

The grinding wheel *B* is mounted on the spindle of a No. 3 "Dumore" grinder, held in the lathe toolpost as shown. The piece of 5/8-inch rolled stock *C*, which is gripped in the collet chuck on the lathe spindle, holds the truing diamond *F*. Holes are drilled in each end of the piece *C* to receive the diamond-holder. One of these holes is drilled at an angle to permit locating the diamond-holder in an angular position, facing to the rear, as shown in Fig. 2. In this position, the diamond is used to true the opposite or back side of the grinding wheel, the compound slide being set at an angle of 30 degrees.

The cross-slide feed is used for feeding the wheel to and fro across the diamond. When the front face of the wheel is being trued, the diamond is held in the hole at the opposite end of *C*, which is parallel with the axis of the lathe spindle. Small set-screws serve to hold the diamond-holder in position in piece *C*. The movement of the diamond in truing the wheel should be from the periphery inward, to prevent the wheel from crumbling at the periphery or crest. Both angles or sides of the wheel are trued at the same setting of the compound slide, the position of the diamond simply being reversed.

After the wheel is carefully trued up to the correct form, the part *A*, Fig. 1, is accurately positioned and clamped to the faceplate. The truing or centering of the work is done by fitting a gland nut in the thread to be ground, and then using an indicator of the internal type to true up the hole

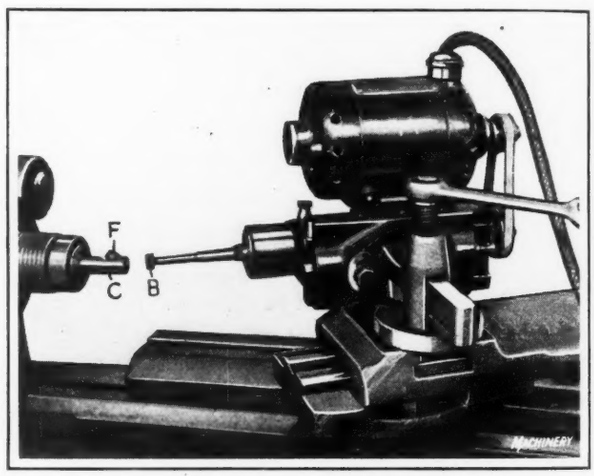


Fig. 2. Truing Wheel for grinding Thread in Part shown at A, Fig. 1

in the gland nut. To facilitate catching the lead, a threaded stud *D* is fitted in the part *A*. This stud extends beyond the part far enough to permit the formed grinding wheel to be brought up and properly set to grind one of the grooves of the thread. The compound slide being set parallel with the shears, permits the wheel to be readily advanced for catching the thread.

It should be remembered that setting the wheel in engagement with the groove at the rear side of the threaded stud is equivalent to setting the wheel to the internal groove within the hole at the opposite side where the grinding is to take place. In this particular case, the wheel was fed along by hand for the reason that the thread did not pass entirely through the part. A stop was fastened to the lathe bed to limit the length ground. By noting the sparks thrown off by the wheel, the workman could determine when the thread was properly ground or entirely cleaned up. A fairly fine grain and hard grade of wheel was used for this job.

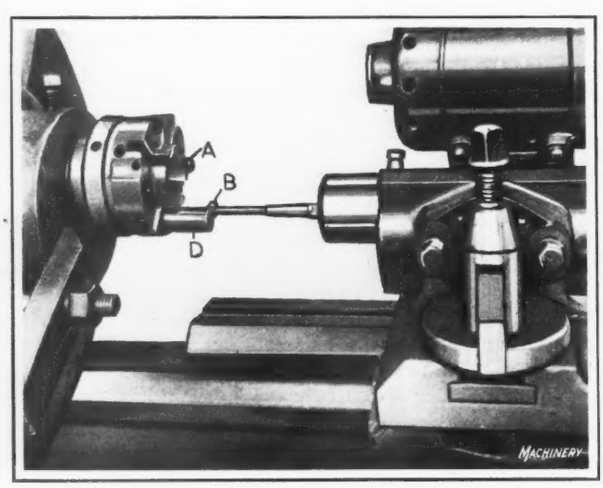


Fig. 1. Method of using Threaded Plug to line up Wheel for grinding Internal Thread

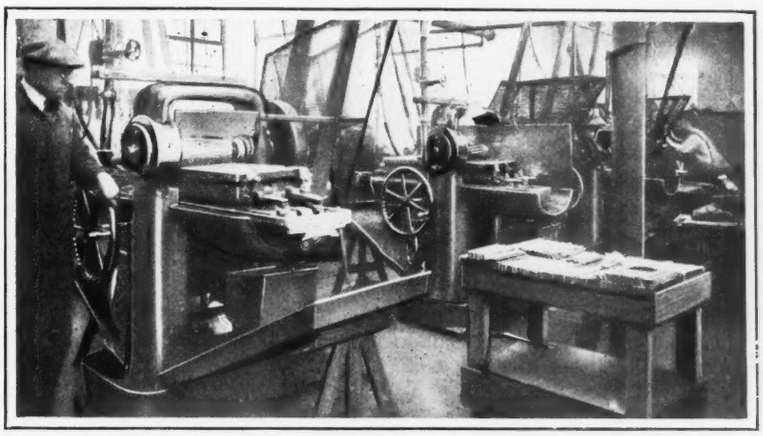
* * *

An innovation in financial advertising has recently been announced. One of the leading investment houses in the country—Hornblower & Weeks—is inaugurating an extensive advertising campaign in the trade and technical magazines announcing that it is prepared to purchase the entire bond issues of sizable and sound American railroads, utilities, and industrial companies. The company maintains offices in most of the large cities of the country.

Making Files by Modern Methods

Description of a Process in which a Tapered Sectional Milling Cutter is Used to Mill File Teeth with an Under-cut or Rake

By CHARLES O. HERB



FILES have come down to us from ancient times as a useful tool for removing small amounts of metal from parts by hand. Way back in the days of Saul, King of Israel, the file was used for sharpening mattocks, colters, forks, axes, and ox-goads, as related in the thirteenth chapter, twenty-first verse, of I Samuel. That period is estimated to be more than three thousand years ago. A file believed to be about 3500 years old was dug up in Crete, and is now in a Canadian Museum. While this file bears an astonishing resemblance to the files of today, the making of it must have been a very crude procedure.

Files are manufactured by several methods based on entirely different principles, but this article will be confined to the method followed by the Service Tool Corporation, Latrobe, Pa. This concern produces "Shearkleen" files, all the teeth of which have a positive rake or under-cut on the front face and a double slope on the back, as illustrated diagrammatically in Fig. 6. The teeth are milled to shape from solid stock by means of a sectional tapered cutter which mills the entire length of a quantity of files at one pass of the machine table.

Preparing the File Blanks for Milling

The files are made in flat, flexible, square, pillar, half-round, and half-oval styles. The teeth may be as fine as 21 per inch, and as coarse as 9 per inch, cross-cut files having from 15 to 32 teeth per inch. In all cases, the teeth have a front rake *A*, Fig. 6, of 3 degrees, a clearance angle *B* of 20 degrees, and a back slope angle *C* of 54 degrees. The depth of the teeth, of course, varies according to the pitch, and the root is always rounded to a generous radius so as to prevent chips from collecting between the teeth. Flexible files are made from a tungsten steel, and all other types from a chrome-vanadium steel.

As the stock is purchased in long bars, the first operation consists of shearing the bars to the proper blank length. All twists produced in the shearing are removed from the blanks by running them through the rolling machine shown in Fig. 1. This machine is equipped with twelve rolls, which are set into different vertical relations so as to kink the work as it passes through them. The first pair of rolls kinks the blank a certain amount, and the successive ones kink it gradually less until the final pair brings it straight. After the blank has passed through the rolls, it is laid on a surface plate to test the straightness. If it does not lie flat on the plate, it is straightened further by a hand method.

Fig. 1. Rolling the File Blanks to straighten them after the Shearing Operation

At least 0.020 inch of stock is next machined from each long edge of the file blank to insure that all decarbonized steel is removed from these surfaces. This operation is performed in the shaper illustrated in Fig. 2. An ordinary tool is employed, but a special fixture is used, in which about thirty-six files can be held at one time. In the middle of the chuck there is an integral rib *A* of substantial thickness, which squares up the files and prevents them from buckling when set-screws *B* are tightened. Flexible files are then drilled and countersunk on each end, and the burrs from these operations are removed by grinding on a floor wheel. The trade name of the file and the name of the company are next stamped simultaneously on each side of the file in a small inclinable power press. By following this method of stamping the two sides at the same time, no distortion of the sides is produced, as was previously the case when only one side of the file was stamped.

The Milling Operation

Undoubtedly, the most interesting operation in the process is the milling of the files, which is illustrated in Fig. 3. As the rake or under-cut on the front face of the file teeth is 3 degrees, the top surface of the magnetic chuck on the milling machine table is inclined the same amount, and the taper of the sectional milling cutter is made to correspond. With this arrangement, the rake of the file teeth is cut in a true vertical plane relative to the axis of the milling cutter. The teeth of the cutter are accurately spaced in annular rows. On most of the files produced, the teeth are milled at an angle of 65 degrees relative to an imaginary line running straight across the file, but in some instances this angle is 75 degrees. To incline the file

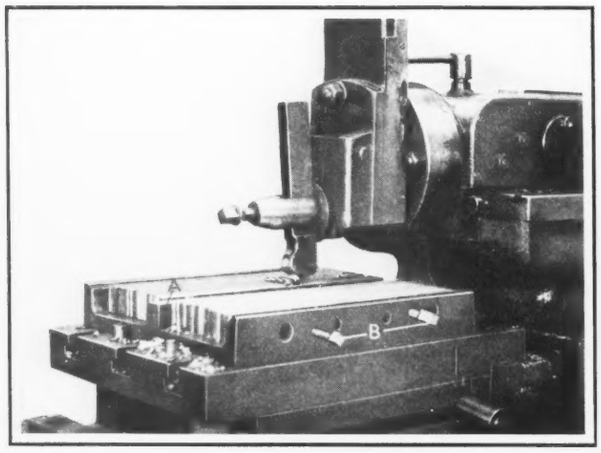


Fig. 2. Machine Set-up employed in shaping Both Edges of the File Blanks

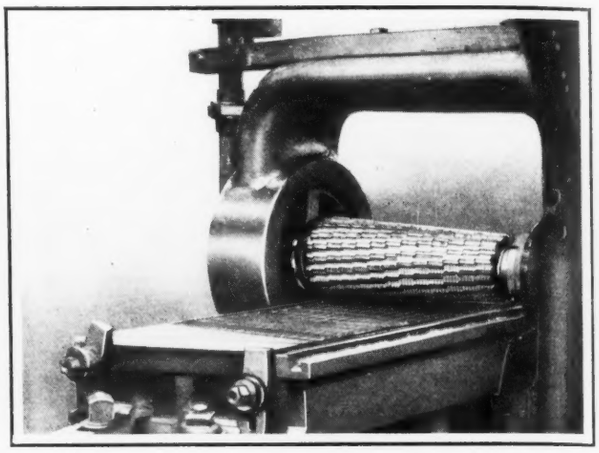


Fig. 3. Milling the Teeth on the Files with a Sectional Tapered Milling Cutter

blanks easily at either of these angles, a sheet-steel templet having one edge finished to the desired angle is fastened to one end of the magnetic chuck. The first file of a batch placed on the chuck is simply laid with one side extending along this templet, and the remaining files are laid against each other in a corresponding manner.

About two dozen files are generally held on the chuck at one time, and milled at one traverse of the chuck past the cutter. An interesting feature of the operation is that the table moves in the same direction as the bottom of the cutter, it being claimed that a much better finish is obtained, because there is less trouble from chips than when the table is operated in the opposite direction. All backlash in the table drive due to the reversed method of feeding, has been eliminated by the provision of a special nut on the lead-screw. Coolant is forced against the bottom of the cutter in copious amounts—50 gallons per minute—to thoroughly wash away all chips. The design of the cutter is such that at least 0.020 inch of stock is cut from the blank before the tops of the teeth are started, in order to insure against any decarbonized steel being included in the teeth.

In milling cross-cut files, the fine cut is taken before the coarse cut, as it has been found that this procedure obviates burrs. After one side of a batch of files has been milled, the files are straightened by hand, and then milled on the opposite side. The straightening is performed by simply laying the file on a lead block, and striking it on each side by means of a hammer covered with rawhide. The workman determines the straightness by his eye. At the end of the second milling, the files are straightened once more in the same manner.

The principal item of expense in the milling operation is the initial and upkeep cost of the milling cutter. Whenever one row of the annular teeth must be reground, it is necessary to grind every row of the entire cutter; otherwise one tooth of the file will be higher than the others. This milling process is patented.

Filing Clearance on Top of the Teeth

After the milling and subsequent straightening, the files are brought to an automatic machine like that shown in Fig. 4, for producing the clearance on the top of the teeth and removing all burrs, jags, etc., from the same surface. The tool employed in this operation is a file held at *A* in an arm *B*, which is hinged so that it may be lowered to bring the filing tool in contact with the work. In operation, the tool is reciprocated back and forth over the work by means of a crank mechanism, in practically the same manner as the saw of a machine hacksaw.

The filing tool is tilted 20 degrees in relation to the plane of the tops of the teeth on the work, so as to file the proper clearance on the teeth on the draw strokes of the machine. Also, the tool is stressed to make it slightly concave longitudinally, which results in the teeth of the work being filed slightly convex and guards against any hollowness in the metal of the work. The front edge of the filing tool is ground at an angle to fit the front face of the work tooth succeeding the one on which the clearance is being ground. Because of this provision and the fact that the tool travels at a slight angle in relation to the path of the teeth on the work, the work is advanced from left to right a distance of one tooth at each stroke of the file. This gives an ingenious automatic feed. A number of files are placed on the table of the machine at one time, and fed into position by gravity. As each file is finished, the succeeding one is automatically pushed into engagement with the filing tool.

Fig. 4. Automatic Machine for filing Clearance on Top of Teeth

Fig. 5. Small Power Hammer used in forming the Tang

A spring-actuated roll beneath the work pushes it upward against a guide plate to insure uniform removal of stock from all the teeth. There are adjustments for regulating the amount that the tool may extend beneath the guide plate, and this, of course, controls the amount of stock filed from the teeth of the work. The work-holding member of the machine may be swiveled to suit the angle at which the work teeth are cut.

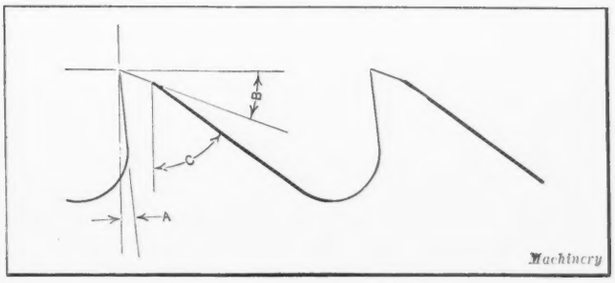


Fig. 6. Diagrammatic Outline of the File Teeth

Forming the Tangs—Making Half-round and Half-oval Files

The next operation on the files consists of forming a tang on one end. This end is first heated to about 1900 degrees F., and then drawn out and shaped between the dies of the small power hammer shown in Fig. 5. It is necessary to produce the tang after the teeth have been milled because of the design of the file. After the tang has been formed, and while still hot, the trade name is stamped on it by allowing weight *A* to drop as the tang rests on block *B*.

Half-round and half-oval files are produced from flat blanks in the same manner as other files, but are milled on one side only. After the tang has been formed on files of this type, the main part of the file is shaped as required, by means of a punch and die such as are illustrated at *A* and *B*, respectively, in Fig. 7, which are used in a small inclinable punch press. This operation is performed with the file heated to a temperature of from 1350 to 1400 degrees F., which is sufficiently beneath the hardening temperature to guard against scale forming on the teeth. The flat file is simply laid in the die and formed to shape as the punch descends on it.

Hardening and Tempering

In the hardening process, the files are heated to the proper temperature by immersing them in a lead bath. It is desirable to prevent the lead from adhering to the teeth during the quenching, and to guard against this, the teeth are covered with a paste consisting of lampblack and flour, preparatory to hardening. This coating is dried by laying the files on steam coils. Later, when the files are removed from the lead bath, one end of the file is tapped lightly on a block, and all particles of lead fall readily from the teeth. To facilitate the removal of the lead, all files are placed in the bath with the front face of the teeth downward.

Each file remains in the lead bath from five to six minutes, or long enough to reach a temperature of about 1440 degrees F., about six files being in the bath at one time. As the hardener withdraws a file from the bath by means of a pair of tongs, he places the blunt end in the slot of a steel block and twists the file slightly to counteract a twist that is produced in the quenching. A curious fact in connection with this twist is that every file of a batch twists in the same direction, but until one or two have been hardened, it is impossible to tell whether they will twist to the right or to the left.

The quenching bath consists of a saturated brine solution which is kept at a certain temperature, within close limits, by means of steam-coil and water circulating systems in the quenching tank. The temperature of the quench varies with different kinds of steel, being 100 degrees F. for some steels and 70 degrees F. for others. Each file is suspended in the brine for one or two minutes by holding the tang between lever-operated jaws located above the tank. As the files are removed from the quench, they are again straightened by tapping lightly with a hammer.

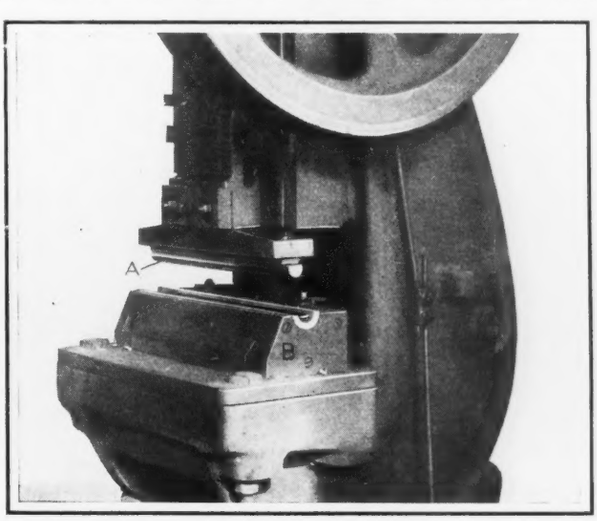


Fig. 7. Equipment used in shaping Half-round and Half-oval Files

For tempering, two or three dozen files are placed at one time on a hanger, which is lowered into an oil bath. The temperature of this bath is maintained at about 350 degrees F., and the files remain in it about twenty minutes.

Special Finishing Process

After the heat-treatment, the files are subjected to a secret process that removes all burrs and scale from both sides of the teeth. This process makes the teeth so smooth that even the soft chips of brass, lead, and aluminum do not stick and clog them. The files are given a final inspection for straightness, hardness and quality.

* * *

PATENT OFFICE COMMITTEE SUBMITS RECOMMENDATIONS

A new modern building, suitably constructed and equipped, increased technical force with adequate salaries, and amendment of existing patent law to facilitate the handling of appeals are among the outstanding needs of the United States Patent Office if it is to render the timely service that American business demands, Secretary Hoover has been advised by the Special Patent Office Committee. The committee originally appointed by Secretary Work of the Interior Department in July, 1924, was enlarged by the addition of two engineers at the time the Patent Office was transferred to the Commerce Department in April, 1925. The committee has completed its full report, which goes into all phases of Patent Office activity, containing one hundred and eight separate recommendations. The five principal features are:

1. The providing of modern equipment, including steel vertical filing cases, which would greatly facilitate the clerical work of the office.

2. The construction of a new building at the earliest possible moment, designed for the special needs of the Patent Office and of ample capacity to provide for present necessity and future growth.

3. A large increase in the technical force of the office, including a larger number of principal and assistant examiners and a larger translating and classification force.

4. An increase in the salaries of all scientific and technical employes, in order to check the large number of resignations and obviate the present excessive rate of turnover.

5. An amendment of the statutes governing practice in the Patent Office, reducing the appeals in interference cases to a single appeal in the office, abolishing appeals to the Court of Appeals of the District of Columbia, and making the decision of the Patent Office final, except as it may be reviewed by the United States District Court in equity proceedings.

BUFFING OVAL AND SQUARE OBJECTS

Oval, square, hexagonal, triangular, and other irregular shaped articles can be conveniently buffed on the type H machine built by the Automatic Buffing Machine Co., Buffalo, N. Y., which was referred to in articles in August and September, 1925, MACHINERY. In such operations, it is necessary to make use of a mechanism that will apply the work at a constant pressure against the buffing wheel.

The mechanism used in buffing an aluminum roaster pan about 12 inches long, 9 inches wide at the maximum point, and 3 1/2 inches deep, is shown in Fig. 1. The dot-and-dash lines indicate the position of the wheel relative to the work. This mechanism and chuck are used for two different pans, the first being indicated by the heavy line, and the second by dotted lines *X*. The distance between the regular machine spindle *A* and the buffing wheel must always be equal to dimension *Y*. In this illustration, the sectional view is taken in the horizontal plane.

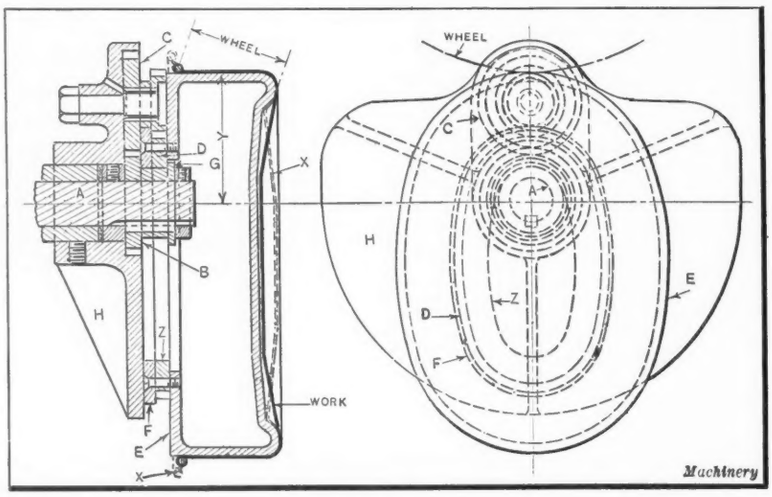


Fig. 1. Mechanism used in buffing an Oval Roaster Pan automatically

Keyed to the machine spindle is a spur gear *B* which drives a compound gear *C*. The front teeth of this compound gear engage a rack *D*, which is fastened to chuck *E* by means of plate *F* and several machine screws and dowel-pins. The outline of rack *D* is made oval to correspond to the shape of the work, and is similarly cut out on the inside, as shown at *Z*. Regardless of the position of the rack, the surface of opening *Z* that is nearest the buffing wheel is always a sliding fit on sleeve *G*, which revolves with the spindle. This fit insures that the work cannot move away from the wheel as pressure is applied for buffing. Housing *H* is stationary on the spindle sleeve, and is of such a design that rack *D* never projects beyond it when the rack, chuck, and plate *F* revolve as one unit. The production per machine, on this operation, is 60 parts per hour, and one man can always tend two type H machines. Castings *E* and *H* are made of aluminum.

A mechanism based on the same principles as the one just described was developed to increase the production rates in buffing escutcheon plates for doors. From Fig. 2 it will be seen that the pieces of work are held between jaws *A*, two of which are secured to each side of a square casting *B*. This casting is driven from the regular machine spindle *C* through gears *D* and *E* and rack *F*. In this case, the rack is square along the outside, with the corners rounded. There is also a machined opening *Z*, which bears along sleeve *D*, in order to provide a firm support for the work as it is applied to the buffing wheel. In addition, the outer edges of plate *H* are guided by strips *J*.

As in the preceding illustration, the sectional view is taken in a horizontal plane, but it will be understood that the work is buffed as it is fed vertically past the wheel. Hence the work moves in a straight direction except when the round corners of the rack move past gear *E*. With this set-up, the average production of each machine is about 500 escutcheon plates per hour. Obviously, the entire time of one man is required to keep a machine loaded. The plates are about 7 1/2 inches long and 2 1/2 inches wide. The same type of mechanism can be employed in buffing square parts with rounded corners; rectangular, triangular, and other irregular shaped parts can be handled by modifying the design.

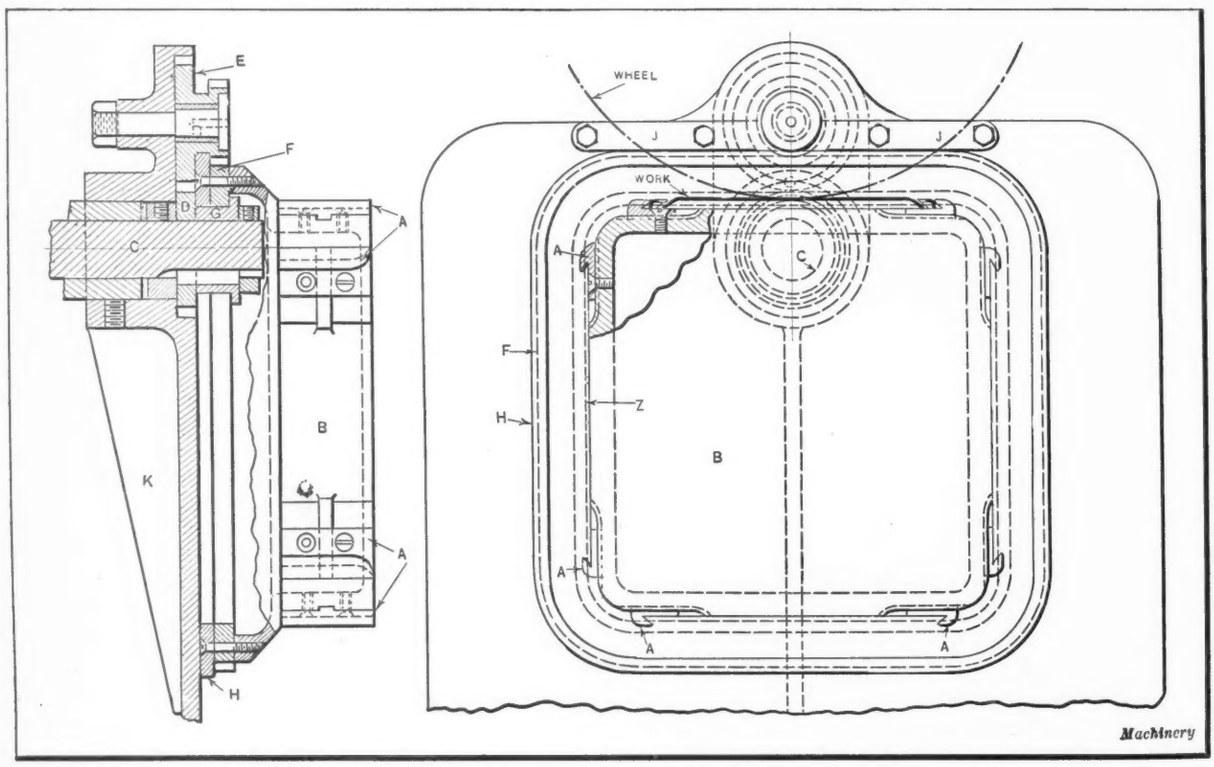


Fig. 2. Buffing Escutcheon Plates on an Attachment that could be arranged for Large Square Work

Notes and Comment on Engineering Topics

Mechanical engineers, especially those that have given particular attention to power problems, are familiar with the term "white coal" which European engineers have introduced in referring to water power. The application of the tidal movement as a source of power has long interested inventors, especially since the development of electric transmission, and the utilization of the power of the waves has also been a matter of recent investigation. To the power thus available in tidal movements and in wave motions, a French journal has applied the term "blue coal."

Work has been started on the fabrication and laying of a steel pipe line for the water supply of Oakland, Cal., which will bring water to the city a distance of ninety miles through the mountains from the Mokelumne River. The steel pipe will be welded by the arc-welding process, using equipment supplied by the Lincoln Electric Co. of Cleveland, Ohio. Numerous tests preceded the adoption of this method for the construction of the pipe line referred to, to ascertain the suitability and reliability of the arc-welding process for this purpose. The test having proved the process satisfactory, work is now in progress on this pipe line.

In an address at the summer meeting of the Society of Automotive Engineers, L. R. Buckendale, of the Timken-Detroit Axle Co., described an improvement of the worm-gear for use in motor coaches and passenger cars. In the new type the worm is underslung beneath the rear axle, which permits the propeller shaft to be hung low, yet gives a ground clearance equal to that of a corresponding bevel gear axle. With a low propeller shaft, the engine, frame, and body can be placed low, which increases safety at high speeds. Moreover, with the worm under the axle, the rise in the floor under the rear seat can be omitted, and the seat placed lower. As a result, more head-room is afforded under a low vehicle top.

At a recent conference on wire and sheet-metal gages held in New York, Colonel E. C. Peck of Cleveland, Ohio, gave the results of some of his investigations into the number of wire gage systems in use. It has been ascertained that there are thirty systems in use to some degree in the United States. Four of these systems use the same sizes, under different names. They include sixteen American, nine English, two German, two French and one unidentified system. There are 1226 sizes listed. It is evident that it is not necessary to have such a large range of sizes to satisfy the needs of the industries. In some cases, the difference between two sizes is less than the tolerance in diameter that the manufacturer of the wire has found it practicable to establish. Certainly the variation between different sizes ought to be greater than the tolerance maintained on the wire itself.

A proposal was recently presented to the Associated Boards of Trade and Chambers of Commerce of Ontario to create in the northern part of that province a lake twice the size of Lake Ontario. It is proposed to build two dams across the Albany and Ogoki Rivers in order to turn the waters of these streams away from the James and Hudson Bays and into Lake Nipigon. This would create a lake 200 miles long by 90 miles wide, and submerge an area of approximately 18,000 square miles. If carried out, the plan will permit a large increase in the amount of electrical energy developed at three centers. The capacity at Cameron Falls would be increased by 175,000 to 200,000 horsepower; that at Sault Ste. Marie, by 40,000 to 50,000 horsepower; and that at Niagara Falls, by about 300,000 horsepower. Altogether, the increase in energy would be over 500,000 horsepower. It is also believed that this new lake would overcome the Chicago diversion of water from the Great Lakes, so that in from twelve to fourteen years the level of the lakes would be back to normal.

It is of interest to note what great savings are effected by modern equipment, not only in the machine shop field but in many other branches of industry, notably the power field. Attention has been called by the General Electric Co. to an installation of turbine-driven boiler feed pumps in the power plant of the Toledo, Bowling Green, and Southern Traction Co. of Findlay, Ohio, where two steam pumps of old design were replaced by a two-stage turbine-driven centrifugal pump, the total saving being equal to a return of nearly 29 per cent on the investment. The new unit also has a 50 per cent greater capacity than the pumps previously used, but occupies only one-quarter of the floor space. The new machine has cost nothing for repairs so far, whereas the old pumps averaged $235 a year for repairs. Other savings are due to the fact that the oil consumption has been reduced from one gallon a day to one-half gallon a month. The achievements of modern engineering in reducing waste are the main reasons for the higher standard of living of recent years.

"Isolantite" is the name of a new product made by the Isolantite Co. of America, Belleville, N. J., for which extraordinary claims are made. It is stated that this material is harder than glass, but not brittle, having a toughness greater than cast iron, that it is capable of resisting incandescent heat followed by a plunge in cold water without damage, that it is practically moisture-proof, and that it can be produced in a soft state so that it can be machined into all kinds of shapes and sizes with great precision, and can have threads cut on it, after which it can be hardened to obtain the extreme properties mentioned. It is unaffected by commercial acids, alkalis, and solvents, and is said to be an exceedingly effective electrical insulator. When in its soft state, it is turned, drilled, milled or threaded in the same manner as metal. The threads are said to be even stronger than metal threads, and machine screws screwed into threaded "Isolantite" are said to have been stripped of their threads before the threads in the "Isolantite" gave way. The material is pure white and smooth in its finished state.

We sometimes hear government engineers criticized for lack of ability, judgment, and interest in their work. Such criticism is often unjustified. When we consider what the government pays for the services it requires in certain of its engineering branches, it is a wonder, not that the engineers employed by the government may sometimes fall short of expectations, but that they are as capable as they are. Here, for example, are the requirements placed upon a civil engineer receiving the munificent salary of $2400 a year. His principal duties consist of performing technical engineering or inspection work requiring a thorough knowledge of the principles of engineering, and the exercise of initiative and of independent judgment; taking charge of a party or parties, large or small, dependent upon the needs of the particular project or undertaking, and directing the work of locating, staking out, and obtaining right of way for highways, involving work in open country, in timbered country, or in extremely rough, mountainous districts.

GALVANIZED WIRE ROPE

Galvanized wire rope is used where the rope is exposed to extreme weather conditions, especially for derrick guys and for ship's rigging, for smokestack guys, etc. Single galvanized wire rope strands are also used for this purpose. Large galvanized wire ropes are used for hawsers and mooring lines on board ship, and for towing purposes. Galvanized rope is not used for general hoisting purposes or where it must be wound upon drums, because the zinc used for the galvanizing wears off rapidly when running over sheaves and drums, and when exposed to abrasion. Galvanized ropes of the same diameters as regular wire ropes have about 10 per cent less strength. Galvanized wire ropes are made in various constructions from six strands with seven wires to the strand, to six strands with thirty-seven wires to the strand.

PIEZOMETER

The piezometer is an instrument or meter used for determining the pressure in a pipe containing water or other fluid. It consists simply of a vertical tube inserted into a pipe containing fluid under pressure. The fluid will then rise in the tube, and the vertical height to which it rises will be equal to the head producing the pressure at the point where the tube is inserted. The instrument is sometimes used for determining the location of obstructions in pipe mains. If the observed pressure at any one point falls below what would be expected under normal conditions, there is an obstruction between this point and the water reservoir. If the pressure recorded by the piezometer is higher than normal, it shows that the pressure at this point has been increased by an obstruction beyond the point where the instrument is located.

QUICK-BREAK LEVER SWITCHES

A quick-break lever switch is a plain lever switch with each pole equipped with an auxiliary blade pivoted to the main blade and so arranged that the auxiliary blade will remain in contact in the contact clip until the main blade has been opened to a certain predetermined amount. Then the auxiliary blade is forced out of contact by an arrangement on the main blade, and quickly follows the main blade due to the action of a spring. The current in the circuit when the switch is opened under load is broken on the auxiliary contacts which are moving rapidly when they leave the contact, thus quickly rupturing the arc without damage to the main blade.

LATENT HEAT

When a body changes from the solid to the liquid state or from the liquid to the gaseous state, a certain amount of heat is used to accomplish this change. This heat does not raise the temperature of the body and is called "latent heat." When the body changes again from the gaseous to the liquid, or from the liquid to the solid state, this quantity of heat is given out by it. The "latent heat of fusion" is the heat supplied to a solid body at the melting point; this heat is absorbed by the body although its temperature remains nearly stationary during the whole operation of melting. The "latent heat of evaporation" is the heat that must be supplied to a liquid at the boiling point to transform the liquid into a vapor. The latent heat is generally given in British thermal units per pound. When it is said that the latent heat of evaporation of water is 966.6, this means that it takes 966.6 heat units to evaporate one pound of water after it has been raised to the boiling point, 212 degrees F.

MOTOR-GENERATOR SETS

A motor-generator is defined in the American Institute of Electrical Engineers' standardizing rules as a transforming device consisting of a motor mechanically coupled to one or more generators. For convenience, motor-generator sets may be divided into three general classes, as follows: (1) Direct current to direct current, including boosters, balancers, and dynamotors. (2) Alternating current to direct current, or vice versa, including light, power, and railway service, and flywheel equalizing sets. (3) Alternating current to alternating current, as in the case of frequency changers.

VALVE DIAGRAMS

In designing a slide valve for a steam engine and the mechanism that operates the valve, it is desirable to be able to determine readily the position of the valve relative to the steam ports, for any given position of the crank or piston. What are known as "valve diagrams" are commonly used for this purpose. These diagrams not only show graphically the relative positions of the valve and crank, but also make it possible to design a valve with reference to a predetermined form of indicator card. Valve diagrams also indicate the effects of changes in the design of the valve on the steam distribution. In connection with steam engine work, certain problems or quantities relating to the point of cut-off, lead, etc., are assumed, and the remaining ones are required and may be determined by means of the valve diagrams. For instance, a designer might be given the point of cut-off, point of release, the lead, and the maximum port opening, the problem being to determine the valve travel, the outside and inside lap, and the angle of advance. By means of a suitable diagram, the valve travel, lap, etc., corresponding to these specified quantities may be readily determined. There are several different forms of valve diagrams, the Zeuner and the Bilgram diagrams being commonly used.

TIN AND ITS PROPERTIES

Tin is a soft metal of white color, almost entirely devoid of tenacity. Its specific gravity varies according to the treatment; cast tin has a specific gravity of about 7.29, rolled tin, 7.30, and electrically deposited tin, from 7.14 to 7.18. Tin melts at a temperature of 232 degrees C. (450 degrees F.), and boils at a temperature of about 1600 degrees C. (about 2900 degrees F.). Its specific heat is 0.056, and its coefficient of linear expansion per unit length, per degree F., is 0.000015. Its thermal conductivity is about 15 (silver = 100), and its electrical conductivity, about 13 (silver = 100). If tin is exposed for any length of time to very low temperatures (— 40 degrees F., for several hours), it becomes so brittle that it disintegrates into a powder. Tin is used in its pure state in the chemical industries for containers, stills, etc. It is employed for making tin foil, for silvering mirrors, for wrapping food products, and for tinning cooking utensils, because it is proof against acid liquids. The most important uses of tin in the industries, however, are in the various alloys which it forms with copper, antimony, and lead. Bronze is, perhaps, the most well known of these alloys, it being composed of copper and tin, the copper content being usually from 80 to 90 per cent, while the remainder is tin. The greater part of tin produced is employed in the making of tin alloys. Tin is the only one of the more important metals that is not produced in the United States to any appreciable extent. The Federated Malay States, Bolivia, and the Dutch East Indies produce the bulk of the world's supply of tin.

A Simple Drafting-room System

By E. H. BRUCE, Engineering Department, Kearney & Trecker Corporation, Milwaukee, Wis.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WIS., U. S. A.

MASTER PARTS LIST

SHEET NO.
FROM PART NO.
TO PART NO.

	PART NUMBER	DWG SIZE	NAME OF PART	MATERIAL	NO. REQD.	FIRST USED ON LOT	LAST USED ON LOT	SUPERSEDES PART	SUPERSEDED BY	REMARKS

SUGGESTED CHANGE FOR PART NO.			
PART NAME		DW'G. SIZE	
SUGGESTED BY		DATE	
APPROVED BY		DATE	
DESCRIPTION OF CHANGE			
TO TAKE EFFECT			
TRACING CHANGED BY	DATE	LAYOUT CHANGED BY	DATE
PARTS LIST CHANGED BY	DATE	CHECKED BY	DATE
PRINTS ORDERED FOR	FOR BOOKS	FOR JIG DEPT.	SEE OTHER SIDE FOR SKETCH

Fig. 3. Blank on which Shop Foreman records Alterations for Engineering Department

by 22 inches (C size), and 22 by 34 inches (D size) are multiples of the A size sheet. These sheets are printed with ruled spaces of sufficient size for all information pertaining to the part detailed on the sheet. The standard title is the same for all the sheets, and is shown in the view of the A size sheet, Fig. 2.

By having one detail on each sheet, the confusion that often arises when two or more men in the shop are required to work from the same print on which several parts are de-

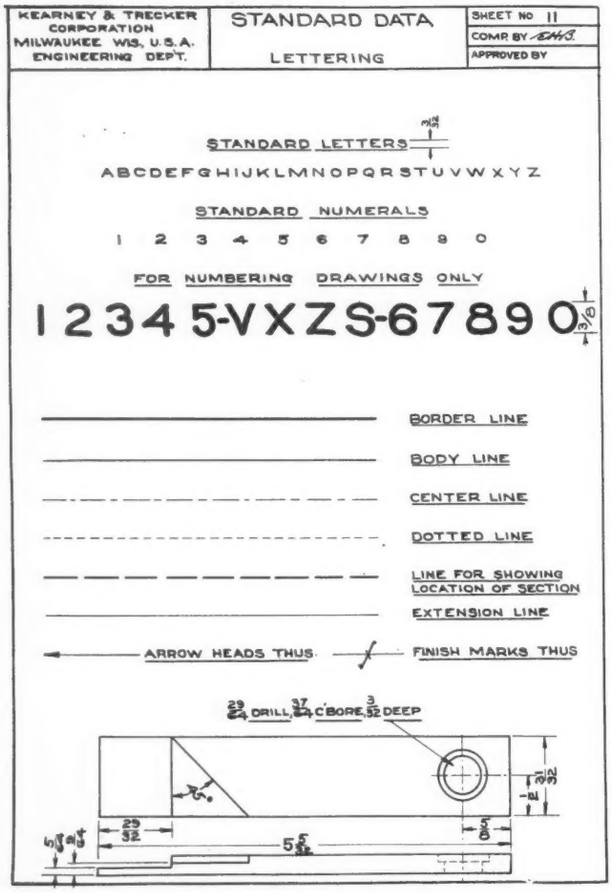


Fig. 4. Standard Data Sheet, showing Style of Lettering and Lines employed in making Detail and Assembly Drawings

tailed is avoided. The third angle of projection is used exclusively, the meaning of which can best be understood by referring to elementary principles of projection as explained in some good text-book.

Master Parts List

Part numbers are given out in numerical order, and a record is kept on the master parts list sheet shown in Fig. 1. Here are kept the important records of the pieces. At the left-hand side of this sheet is a space for the part number; then follow spaces for the size of drawing sheet, name of part, kind of material, number of parts required, lot number on which the part was first used, lot number on which the part was last used, number of superseded and superseding part, and remarks.

Record of Alterations

Records of alterations on parts are furnished to the engineering department by the foreman in the shop on blanks like the one shown in Fig. 3. After the required alterations have been made in the tracings and checked, the alteration slips are filed away systematically, according to the number of the part changed.

All minor changes are recorded in spaces reserved for the purpose in the upper right-hand corner of the detail sheet,

MACHINE	VAULT RECEIPT							
THE FOLLOWING DRAWINGS OR TRACINGS HAVE BEEN RECEIVED FROM VAULT CLERK BY THE UNDERSIGNED WHO HOLDS HIMSELF RESPONSIBLE FOR THEM UNTIL RETURNED								
NAME					DATE			
NUMBER	D	T	NUMBER	D	T	NUMBER	D	T

Fig. 5. Receipt Blank filled out by Designer or Draftsman when Tracings or Drawings are taken from Vault

provided the part is not changed sufficiently to make it obsolete as a repair part. When the change is such that the part cannot be used as a repair part for machines previously made, it is superseded by a new part having a new part number. The master parts list contains the record of new and superseded pieces.

Assembly Drawings

Assembly drawings are made to as large a standard scale as possible, the scales employed being one-half, one-fourth, three-eighths, etc. The assembly sheets have part numbers listed for each part, as shown on the assembly sheet, Fig. 2. A set of bound assembly drawings is provided for each department in the shop.

Vault Records—Instruction Sheets

Tracings, drawings, and lay-outs must not leave the engineering department, and each draftsman or designer is required to fill out a vault receipt, such as is shown in Fig. 5,

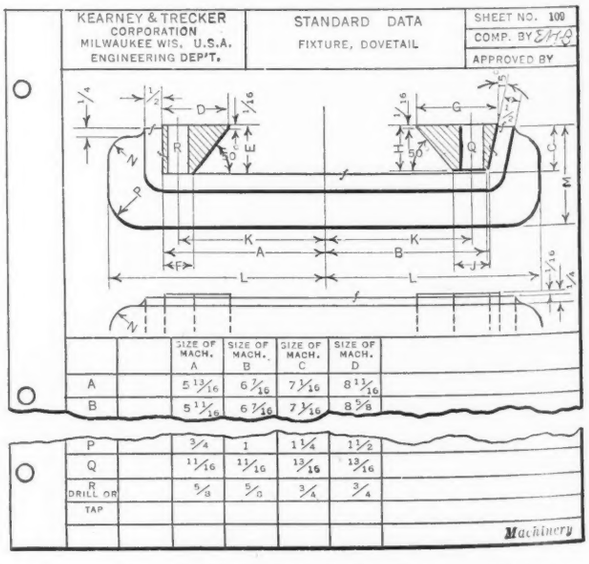


Fig. 6. Standard Data Sheet used when Parts are made in Various Sizes

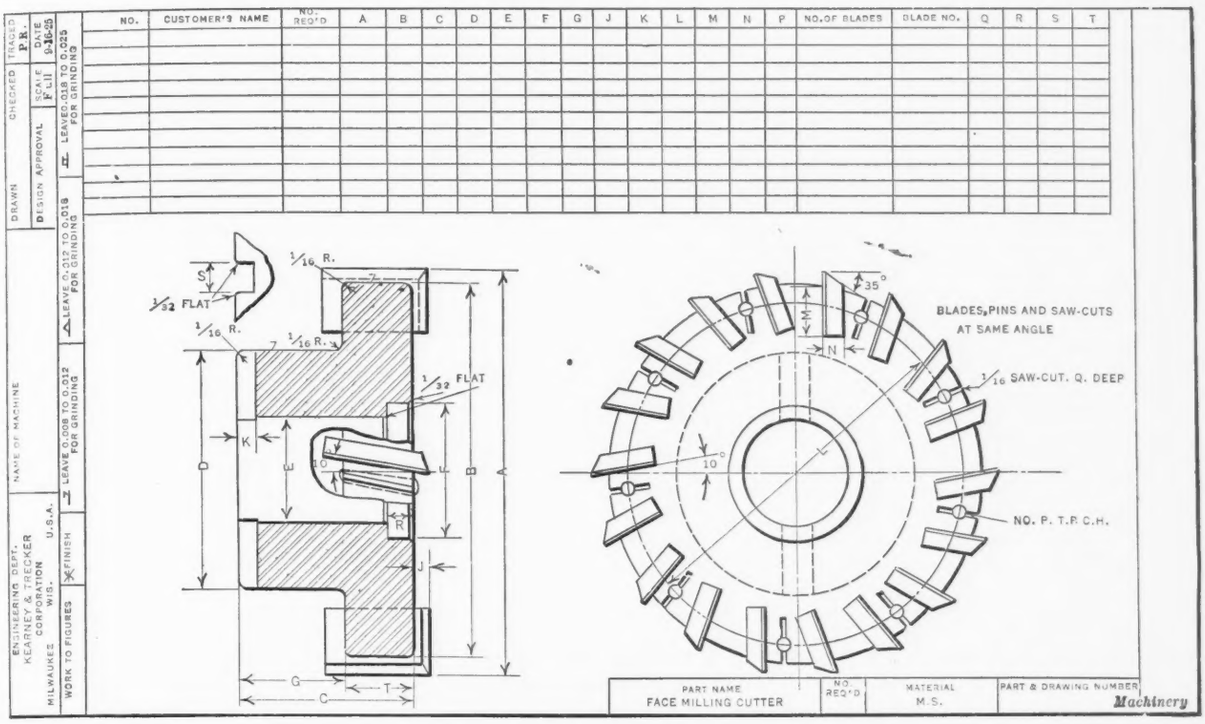


Fig. 7. Special Cutter Detail Sheet which can be dimensioned to meet Requirements

when he takes tracings, drawings, and lay-outs from the vault. These slips remain with the blueprint department until the property is returned, at which time they are either returned to the person to whom they have been issued or destroyed.

Instruction sheets and data sheets, of which there are many, are furnished to each draftsman. All draftsmen are requested to follow the rules given on these sheets as closely as possible. Examples of standard data sheets are shown in Figs. 4 and 6.

Tracings for special cutters and arbors are made up with certain dimensions lettered. The blank spaces on prints made from these tracings can be easily filled in to meet the requirements of special orders. This method saves considerable time, and serves the same purpose as an entirely new tracing. An example of one of the special cutter sheets is shown in Fig. 7.

List of Parts for Lot Order

A parts list is kept for each size and type of machine, which gives the part number, the size of the sheet on which the part is detailed, the name of the part, the material and the heat-treatment required, if any, the number of pieces required for each machine, and the type of the machine. This list is kept up to date for each lot of machines ordered. A blueprint list is made from the parts list and bound. This list also contains the lot number, number of machines or parts in the lot, and the date. The bound list is filed away for use in filling repair orders. One of the parts list sheets is shown in Fig. 8.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WIS., U. S. A.
MF'G. [redacted]
PLAIN
UNIV.

PARTS LIST

No. 3B HORIZONTAL MACHINE

SHEET NO. 1
NO. OF SHEETS
NO. IN LOT DATE
LOT NO. [redacted]

PART NUMBER	DW'G. SIZE	PART NAME	MATERIAL	HORIZONTAL [redacted] M.	HORIZONTAL [redacted] P.	HORIZONTAL [redacted] U.	VERT. [redacted] M.	VERT. [redacted] P.	REMARKS
3000	A	Hand Trip Lever Shaft	M.S.		1	1			
3001	A	Feed & R.T. Drive Gear	SAE-3115		1	1			
3002	B	Table Screw (Large)	Brass		2	2			
3003	B	Table Screw (Small)	Brass		2	2			
3004	A	R.T. Clutch Shifter Link	C.R.S.		1	1			
3005	A	Univ. Joint Sleeve Stud	MS-CH		1	1			
3006	A	Table Trip Eccentric Bshg.	C.I.			1			
3007	A	Table Trip Eccentric	MS-CH		1	1			
3008	A	Front Cross Feed Screw Bearing	Bronze		1	1			
3009	A	Knee Elev. Screw Bearing	Bronze		1	1			
3010	A	Elev. Feed Gear Fork	M.I.		1	1			
3011	A	Universal Joint Sleeve	C.R.S.		1	1			
3012	A	Universal Joint Shaft	MS-CH		2	2			
3013	A	R.T. Clutch Gear	3115-CH		1	1			
3014	A	R.T. Clutch Shaft	MS-CH		1	1			
3015	A	R.T. Shaft Bearing	C.I.		1	1			
3016	A	Clutch Key	C.R.S.		3	3			
3017	A	Clutch Gear Bushing	C.I.		1	1			
3018	A	Clutch Shaft Bushing	C.I.		1	1			
3019	A	Clutch Cone Bushing	C.I.		1	1			
3020	A	Clutch Cone	MS-CH		1	1			

Fig. 8. Parts List Sheet, which is made out for Each Machine

List of Stock Parts

As a large number of miscellaneous parts are purchased or made outside the plant and carried in stock, a stock parts list is made up, and kept with the various lists for each size and type of machine. These lists cover such parts as screws, nuts, dowels, washers, roller bearings, etc. Lists of this kind are a great help to the assembly department in ordering the stock-room to deliver the standard parts for all the machines of one lot. The stock parts are then on hand ready to be assembled before the machine

parts are received. The stock parts are grouped and listed as shown on the stock parts list in Fig. 12.

All special jobs that require engineering work are given an "S" number, and if the shop is to do the work, the job is also given an "R" number. The "S" or special number is recorded in the special order book, together with a brief description of the job, as will be seen by referring to Fig. 14.

BLUEPRINT ORDER

NEW _____ REPLACED _____ SUPERSEDED _____ RECORD _____

ORDERED BY _____ DATE ORDERED _____

DRAWING SIZE & PART NO. | NO. OF PRINTS WANTED

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DEPTS.	PATT.	MACH.	JIG	ENG. 1	ENG. 2	PLANNING	STOCK	ASSEM	S
BOOK PRINTS									
LOOSE PRINTS									

REMARKS | DATE DELIVERED _____ DELIVERED BY _____ *Machinery*

Fig. 9. Blank used in ordering Blueprints

SPECIAL ORDER NUMBER | PART & DWG. NO.

BOOK PRINT																
LOOSE PRINT																
SPECIAL ORDER PRINTS																
DEP'T NOS.	ENG. DEP'T.	PL. DEP'T	2	4	5	8	10	12	14	16	17	20	21			

Machinery

Fig. 10. Blueprint Record Card

Form 128

PHOTOSTAT PRINTS WANTED

PRINT NO. .....

SIZE OF PRINT WANTED .....

NO. OF PRINTS WANTED .....

DATE ORDERED .....; DATE FINISHED .....

ORDERED BY .....; APPROVED BY .....

CHARGE TO	Prod. Dept.	Adv. Dept.	Sales Dept.	Patent Dept.	Eng. Dept.		

Fig. 11. Photostat Order Blank

Blueprint Orders

Orders are made out for all prints that are to be replaced in the shop (see Fig. 9). The attention of the pattern shop, tool department, and planning department is called to a change in a part by a large white arrow-head pointing to the change. A soft lead-pencil is used to draw the arrow-heads on the tracing, and as new changes are made and recorded, the older arrow-heads are erased. The only exception to this rule is when a new lot of machines has been ordered and the department issues orders for blueprints covering the job. In such cases, the orders for the prints are made out on blanks like the one shown in Fig. 15. These blanks are attached to the blueprints, and follow the work through the various departments in the shop to the assembly department.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WIS., U. S. A.
MF'G. [redacted]
PLAIN
UNIV.

STOCK PARTS LIST

No. 3B Horizontal Machine

SHEET NO. 1
NO. OF SHEETS _____
NO. IN LOT _____ DATE _____
LOT NO. [redacted]

PART NUMBER	DWG. SIZE	DESCRIPTION	MATERIAL	NO. REQ'D	USED WITH PART NO.	REMARKS
Dowels		3/16 long		2	3019	
"		1/4 x 1-1/2 long		2	3008	
"		5/16 x 2 long		1	3024	
"		1/2 x 1-1/2 long		3	3021	
Glass		1/23/32 Dia. Double Thick		1	3025	
K-102		Key		1	3023	
K-112		"		1	3027	
K-154		"		1	3015	
K-162		"		1	3017	
K-174		"		1	3029	
K-179		"		1	3026	
K-185		"		1	3012	
K-193		"		1	3014	
#11		Woodruff Key		1	3124	
#15		" "		1	3127	
#15		" "		1	3129	
#18		" "		1	3135	
#18		" "		1	3137	
N-3		Nut		2	3148	
N-4		"		2	3135	
N-5		"		2	3147	
N-6		"		4	3153	
N-11		"		2	3159	
Oiler		#2 Oiler		1	3157	
"		5/16 Ball Oiler		1	3152	

Fig. 12. Stock Parts List Sheet

Blueprint Records

A record is kept of all blueprints placed in the reference blueprint books in the shop. As there are only six books of this kind for each size of machine, it is an easy matter to date each print and the record card. This record card is kept on file in the blueprint department. The front side of one of these cards is shown in Fig. 10. On the back side of this card is a space for stamping the dates when the prints go to the shop. Charge numbers are issued for each style of standard machines and attachments, and the draftsmen and designers, when working on any of these jobs, record their time on cards like the one in Fig. 13, which have the charge number on them.

Photostat Prints

The photostat machine is installed in the engineering department, and is operated by the blueprint department, which makes sure that all orders for photostats are filled out on an order blank like the one shown in Fig. 11. This work, the material, and the labor are charged to the department that orders the photostat prints.

PLANS FOR A MUSEUM OF PEACEFUL ARTS

As mentioned in July MACHINERY, the bequest of the late Henry R. Towne makes possible the establishment of a Museum of Peaceful Arts in New York City. The plans for the machine tool section of this museum are now being developed, and it is intended to have three different divisions in this section. The first one will contain samples of elements of machines and machine shop accessories. In this division, there will be twelve classes, as follows: Hand tools, machine cutting tools, grinding and polishing devices, slide rests, chucks and clamping devices, screws, gears, cams, power transmission equipment, hoists and cranes, measuring instruments, and means and methods of generating surfaces.

In the second division, there will be machine tools of all classes, grouped by their most important types. It is intended to show the history of each type from its primitive form up to the present development. The kind of work for which each type is best adapted will be indicated.

The third division will show old shops with tools typical of the periods chosen. All the details—the kind of product worked upon, the lighting, the work-benches, shafting, etc.—will be characteristic of each period. It is proposed to have a room for each of the following years: 1776, 1800, 1820, 1840, 1860, 1880, 1900, and 1920.

Suggestions that might help in the development and realization of these plans are invited. Any information as to old tools or shops throughout the country, particularly hand tools and primitive shop equipment, old pictures, original drawings, and descriptions or photographs that will help in reproducing the old shops, will be of great assistance. Authentic accounts of the shop practices will help greatly in reproducing the atmosphere. Of equal or even greater value than the suggestions outlined will be the contribution of originals or information regarding available originals that could form a part of this collection, which promises to be unique in the world. Any one who can help in connection with any of the three divisions outlined is requested to communicate with the Museum of Peaceful Arts, 29 W. 39th St., New York City.

* * *

According to *Commerce Reports*, the imports of machinery into Chile are showing constant growth. In 1924, the last year for which complete detail figures are available, the imports of machinery of all kinds were valued at $17,300,000, of which the United States furnished $7,550,000 worth, Germany about $3,600,000 worth, and Great Britain somewhat over $4,000,000 worth. The United States sent machine tools to Chile in that year to a value of about $210,000, of which lathes represented $47,000, and pneumatic portable tools $50,000. The value of small tools exported was about $17,000. The imports of mining and quarrying machinery amounted to slightly over $1,000,000.

Form 129 6-20

KEARNEY & TRECKER CORPORATION

ENGINEERING DEPT. TIME CARD

Clock No._____ Period Ending_____

Name _____

CHARGE ACCOUNTS

Date																														Total Time
16																														
1-17																														
2-18																														
3-19																														
4-20																														
5-21																														
6-22																														
7-23																														
8-24																														
9-25																														
10-26																														
11-27																														
12-28																														
13-29																														
14-30																														
15-31																														

Approved_____

Fig. 13. Card on which Draftsmen and Designers keep Record of their Time on Charge Accounts

Drawing No.	Description	Photo No.	Date
S-1030	Fixture with removable Jaws for Milling Slots in six each 1", 1¼", 1½" & 2" Disc Holders. R-4634, EI-840. For use on No. 2-B Plain. Crane Co.	1106 1107 1108 1109	2/18/25
S-1031	Special Compression Collets for Large Cutters. R-4635, EI-840. For use on 2-B Plain. Crane Co., Dept. 5, D-2 Bldg., Chicago, Ill.		2/18/25
S-1032	Milling Machine Fixture to hold 6 pieces. K-6 - 03 Buckets. R.4652, EI-655 B-3. For use on No. 3-B Plain. Blackmer Rotary Pump Co., Petoskey, Mich.		2/20/25
S-1033	Milling Fixture to hold 10 pieces: K-5, K-9 Buckets. R.4653, EI-655 B-2. For use on 3-B Plain Machine. Blackmer Rotary Pump Co., Petoskey, Mich.		2/20/25
S-1034	Special Cutter Arbor. R.4654, EI-655 B-2. For use on 3-B Plain Machine. Blackmer Rotary Pump Co., Petoskey, Mich.		2/20/25
S-1035	4 Spindle Attachment, 3 Vertical, 1 Horizontal R-4667, EI-659 C-1. For use on 3-B Plain. Blackmer Rotary Pump Co., Grand Rapids, Mich.		2/20/25
S-1036	Fixture to hold 3 C-5 & C-9 Pump Pistons. Extra Collets. R-4668, EI-659 C.I. For use on 3-B Plain Machine. Blackmer Rotary Pump Co., Grand Rapids, Mich.	1150 1151 1152 1153 1154 1155	2/20/25
S-1037	Indexing Fixture. R-4670 EI-837-1. For use on #3-B Machine. Blackmer Rotary Pump Co., Grand Rapids, Mich.		2/21/25
S-1038	19-1/2" Vert. Feed, 20-5/8" Vert. Movement. For use on #4 Vert. Kermath Mfg. Co., Detroit, Mich.		2/23/25
S-1039	5 Spindle Dividing Head with Tail Stock & Adj. Support. EI-881, 881-A, 881-B. For use on 3-B Plain Machine. Crane Co.	1062 1063 1064 1065 1066	2/25/25

Fig. 14. Record Sheet of Special Order Book

Form 315. 7-15-10M

ORDER NO._____

PART NO._____

NAME_____

DRAWING NO._____

MATERIAL_____

NO. TO START_____ TOTAL FINISHED_____

IN STOCK_____ READY FOR_____

DEPT. NO.	NO. SPOILED	NO. DEFECTIVE	NO. FINISHED

COUNT PIECES WHEN STARTING JOB AND REPORT AT ONCE TO YOUR FOREMAN IF NUMBER IS NOT CORRECT.
REPORT TO FOREMAN IF ANY ARE SPOILED OR DEFECTIVE.
FOREMAN REPORT TO STOREKEEPER NUMBER OF PIECES SPOILED OR DEFECTIVE.
WORKMEN WILL BE HELD RESPONSIBLE FOR THE CARE OF THIS TAG AND KEEPING IT WITH THE WORK.

PART NO._____

ORDER NO._____

NAME_____

MATERIAL_____

NO. STARTED_____

Fig. 15. Blueprint Order for New Work

What MACHINERY'S Readers Think

on Subjects of General Interest in the Mechanical Field

THE VALUE OF TRAINING

The advantage that the skilled worker has over the unskilled worker is well illustrated by the figures on wages in the industries, collected by the National Industrial Conference Board. Recent figures compiled by this board show that in the iron and steel industry, for example, the average hourly wage for unskilled labor is about 50 cents, while the average wage for skilled labor is over 70 cents. In the automobile industry, the comparison between skilled and unskilled labor is 51 and 72 cents, respectively, and in the foundry field, 51 and 68 cents. In other words, by obtaining the required training and becoming a skilled worker, a young man practically assures himself of an income 40 per cent greater than he can expect if engaged in an unskilled occupation.

R. V.

* * *

A TESTING LABORATORY FOR TOOLS

A testing laboratory for small tools conducted on a national basis is urgently needed. The Bureau of Standards can undertake some of this work, but hardly on a scale large enough for the needs of the industries. We have, for example, no definite and reliable data on what kind of steel is the best for tools such as broaches, threading taps, drills, drawing dies, etc. High-speed steel, low-tungsten steel, and carbon steel are all used for tools, but no definite information is available as to when one kind of steel is better than the other. Some buyers specify high-speed steel when the tool manufacturer believes that carbon steel would give better results. Some tool manufacturers hold that low-tungsten steel is better than either high-speed steel or carbon steel for many purposes; but there is no uniformity of opinion, and only actual tests undertaken by a national laboratory, independent of both the maker of the tools and the user, could be expected to furnish to the industry this definite information.

It is possible that great sums are wasted annually by using high-speed steel for purposes for which carbon steel would be equally efficient. On the other hand, it is likely that the use of carbon steel still persists in instances where high-speed steel is the only proper material to use. The possibilities of low-tungsten steel have only begun to be appreciated. The metal-working industries produce billions of dollars worth of equipment annually. Would it not be worth while for these industries to tax themselves, each in their place, a very small percentage of their annual output, with a view to creating a testing laboratory that could give them definite information on points of this kind, and save all of them from the continued waste due to lack of knowledge on essential points?

OBSERVER

* * *

KEEPING SALESMEN WAITING

Firms buying shop equipment expect the greatest efficiency on the part of the machines and tools bought. Efficiency is expected in the shop operations, and waste of time in the shop is considered an evidence of inefficient management. In efforts to prevent waste and establish efficiency in all industrial relations, the waste of time in the lobbies of manufacturing concerns, where salesmen sometimes have to wait for hours to see a purchasing agent or buying engineer, has, however, been overlooked. It is extremely gratifying to note that some firms have recognized this condition, and it is to be hoped that the examples set by them will be followed by others. If a man cannot be seen right away or within a comparatively few minutes, he should be told how long he is likely to have to wait, so that he might be able to use his time to better advantage than waiting in an office lobby for an indefinite appointment.

The following announcement, seen in the reception room of the Baldwin Chain & Mfg. Co., Worcester, Mass., and signed by William A. Rockenfield, general manager, proclaims a policy well worth following. The announcement reads as follows:

"To All Salesmen and Advertising Solicitors—You Are Welcome. We have salesmen of our own, and we hope they will be received courteously by the concern you represent, and given reasonable hearing. We expect to receive you in the same fashion. Our purchasing agent is a trusted and responsible part of the organization. He is in intimate touch with our requirements, and part of his job is interviewing you. He is anxious to find products and means that will allow us to manufacture a better product more cheaply. He is in a position to discriminate whether or not it is policy for you to see other department heads on all items. Ask him. His name is A. W. Warren."

A similar announcement was seen by the writer some time ago at the plant of the Reynolds Machine Co., Massillon, Ohio, and is also well worth quoting. This announcement reads as follows:

"Welcome Salesmen: The manager of this business was for several years a traveling man. If you are obliged to wait more than ten minutes, ask our telephone operator to connect you with the manager's office."

O. F. Binford, general manager of the Reynolds Machine Co., in referring to this sign, mentioned that men who have never had any experience on the road themselves invariably reflect it in their treatment of callers. It is often possible to pick out those men who have had outside work and those whose work has been mainly confined to their own office, by simply noting the manner in which they deal with a traveling salesman.

JOHN METCALF

* * *

COST OF REPAIR PARTS

The comments on advertising page 2 of May MACHINERY—which are very much to the point—prompt the writer to express some additional opinions on this subject. In doing so, he has taken the liberty to quote largely from a bulletin by Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, in which it is pointed out that there are numerous items of unavoidable expense involved in the booking of every order, regardless of the value of the order. Every order received is booked at approximately the same cost for accounting, but there are some expense items connected with the entering of repair orders that do not appear in the entering of an order for a regular product. The repair order must be carefully supervised by a competent person in the seller's office. It involves looking up old records, and if the order is for a part made from a casting, it may involve looking up patterns, getting them over to the foundry, following the work through the foundry, and of course the patterns themselves involve expense—fire risk, storage, insurance, etc.

The costs of producing a repair part are always very large, compared with producing the same part in standard production. A single item has to be followed through the shop, and tool set-ups for a regular product may have to be torn down in order to accelerate the repair part work. Then, after the work on the repair part is done, the tools have to be set up again for the regular job. The cost of supervision is always

very great when a single piece is put through the shop. If one were to list all the skilled and semi-skilled operators employed in the production of a single small repair order, the list would be surprising.

After the piece is made, the cost of billing and shipping is practically the same on a small repair part as it is on a large order. This cost is out of proportion to the apparent size of the piece. Investigations made in other industries as to the cost of merely entering and shipping an order show that the combined expense hardly ever amounts to less than $2.50 per order. If, then, the order itself is billed at less than this amount, the customer actually receives all of this service at a total loss of the cost of producing the piece, and at some loss for entering the order.

When, therefore, a customer makes a complaint that the price of a repair part seems to be unreasonable, it would take very little consideration on his part to see that perhaps he has paid an unreasonably low price for the repair, rather than an unreasonably high one. L. T. T.

* * *

OWNERSHIP RIGHTS IN ENGINEERING SERVICE

There appear to be some very vague conceptions in regard to the ownership rights in engineering service. In many instances, buyers of shop equipment involving engineering service seem to overlook the fact altogether that unless the service itself has been specifically bought and paid for, like consulting engineering service, it is not ethical to make use of it in placing business with a competitor of the manufacturer who has rendered the engineering service in the first place.

For example, a manufacturer of tooling equipment frequently solves a production problem for one of his customers, and furnishes drawings indicating how increased production and satisfactory results may be obtained. In some cases, these drawings are used by the buyer to obtain bids from a number of competing concerns. It is evident that the concerns who did not have to render the engineering service, but simply were required to do the mechanical work of building the device, could bid lower than the originator and designer of the device. Under such circumstances, the engineering department of the designer has simply been used to enable a competitor, who may have no adequate engineering department, to obtain an order.

In some cases, the first order may be placed with the manufacturer who designed the equipment, and subsequent orders placed with competitors, using the first manufacturer's blueprints. Unless the engineering work has been specifically paid for in full in connection with the first order, this is not an ethical procedure.

No manufacturer has a right to send out blueprints obtained from another manufacturer, and ask for bids on them, unless the designing work has been fully paid for as consulting engineering service. The writer hopes that the ethics of the mechanical engineering field in this respect may be raised through the action of various trade associations and engineering societies. FAIR PLAY

* * *

WHAT CONSTITUTES "OVERHEAD"?

The expression "overhead" is frequently used in articles relating to cost of production. The meaning of the term is perfectly clear to the executive and the accountant, but it is not always clear to the shop man. It is important that the shop man should have a good idea of what constitutes overhead, in order that he may understand the relation between wages and the price of the product sold by the concern employing him.

Many shop men, unfamiliar with all the different items of expense incident to conducting a business, have an idea that profits must be exorbitant when they learn that their wages, for example, are only 40 per cent of the selling price of the product. They forget the cost of the materials and the items that are grouped together as overhead.

It may therefore be of interest to record the different main items of cost that enter into the selling price in addition to wages. Any man who reads the list below will appreciate that wages are not the whole item of expense, but, on the contrary, often a comparatively small part of the expenses of a firm.

In addition to the wages paid to the employes who are directly engaged on production work, there are the salaries that must be paid to the officials who manage the concern, and the salaries and wages of employes in the office, drafting-room, stock-room, shipping room, and other departments that are not engaged in production. Then there is the cost of materials—castings of all kinds, forgings, steel bars, tubing, and parts that are bought ready made, like bolts, nuts, rivets, and taper pins. Then come the materials that are not used in the finished product, but are used in the production. Among these are oil, grease, waste, wiping rags, small tools, belting, oxygen and acetylene for welding, packing lumber, and office supplies. Finally come the costs generally grouped together as overhead—interest on the investment in machinery and buildings; interest on borrowed money needed to conduct the business; depreciation on shop equipment; repairs to machinery and equipment; cost of heat, light, and electric current for power; freight and express charges; telegrams and telephone service; postage; cost of printing catalogues and advertising; cost of maintaining a selling organization, including salesmen's salaries, traveling expenses, and rent for showrooms; cost of showing product at exhibitions and membership dues in trade associations; municipal, county, state, and federal taxes; fire insurance; and workmen's compensation insurance.

If there is anything left after all the bills for the things mentioned have been paid, that which is left is profit. Sometimes there is something left and sometimes there is not. If there is nothing left for a period of years, the firm ultimately goes out of business. EDWARD JUDSON

* * *

BUYING ON THE BASIS OF PRICE INSTEAD OF QUALITY

Editorials and other articles have appeared from time to time in MACHINERY calling attention to the fact that many buyers permit price to influence them to the extent of neglecting quality when buying tools and machine shop equipment. The writer has found this to be especially true in the case of large corporations having headquarters in one locality and branch factories distributed throughout the country. The mechanical department of a branch factory may request a certain make or type of machine, because the production executive knows that this particular machine will give the best service for his needs.

The purchasing department, located perhaps a thousand miles or more away from the factory, after having examined the requisition, will ask for bids from a number of makers of similar machines, and finding that one is much cheaper than the others, will buy the cheaper one, not understanding that, for the purpose for which it must be used, it may be entirely unsuitable. The machine may be too light for the work in hand, it may not have the required speeds and feeds, it may not have the power, and it may be lacking in certain operating features that are provided in the machine requested; yet, the general trade designation of the two machines may be the same, and to the purchasing department there is no difference between the two. The result is that a machine may be bought that is not wanted by the shop that has made the request after having carefully studied its needs.

The machine tool builder may have been in touch with the mechanical department of the branch factory and helped the executive there to decide upon the type of machine required for his peculiar needs, and may thereby have added to his selling costs; and yet, all this effort and service goes for naught and is merely an added item of expense, because the men who are to use the machine are not given an opportunity to have a deciding voice in buying it.

MANUFACTURER

DRILLING HOLES IN REVOLVING WORK

In machining the brake-drums for the rear wheels of the automobile trucks built by the White Motor Co., Cleveland, Ohio, production rates have been substantially increased by drilling the bolt holes in the same machine as that in which the boring, reaming, and facing cuts are taken. This method has eliminated one operation. A unique feature of the drilling operation is that both the work and the drills revolve. The part is finished in two operations on semi-automatic machines equipped with the tooling illustrated in Figs. 1 and 3. The bolt holes are indicated at *a* in Fig. 2, which shows one model of the brake-drum. Other models have five and six holes instead of twelve.

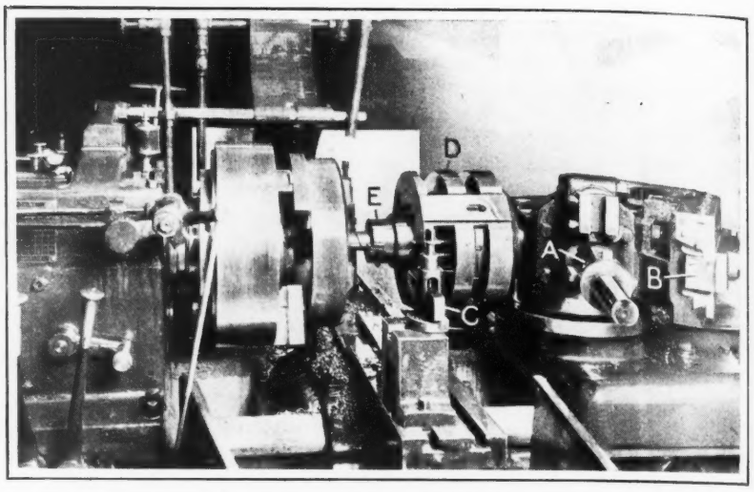


Fig. 1. First Operation on the Brake-drum in which Twelve Holes are drilled while the Work is revolving

The machine used for the first operation is equipped with the tooling shown in Fig. 1. The first step consists of rough-boring hole *b*, Fig. 2, with tools mounted in head *A*, Fig. 1, held in the turret. In the second step, tools on slide *B* rough-face seat *c*, Fig. 2, and chamfer corner *d*. To accomplish this, slide *B*, Fig. 1, is fed transversely by feeding the cross-slide in such a way that bar *C* in the front toolpost pushes against slide *B*. The third step consists of finish-facing seat *c*, Fig. 2, by means of tools held in a slide on the fourth side of the turret, this slide being fed transversely in the same manner as slide *B*.

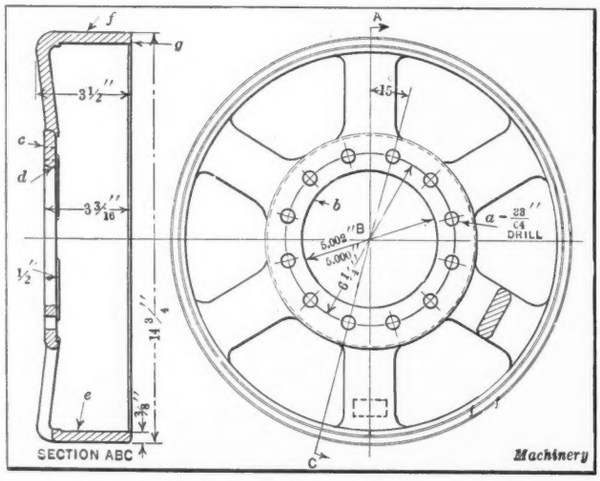


Fig. 2. Brake-drum machined by the Use of the Equipment illustrated in Figs. 1 and 3

Hole *b* is next reamed by a reamer held in the fifth side of the turret, after which the turret is indexed once more to bring the multiple-spindle drill head *D*, Fig. 1, in line with the work. A pilot on the head enters the machine spindle to steady the head during the operation, and the head is driven in unison with the work by a dog on part *E* which contacts with a lug on the spindle nose. Gears in the drill head cause the drills to revolve on their own axes at the desired speed. The forward ring of the drill head contains bushings for the drills, and it is pushed back against the action of coil springs as the turret continues to advance after this ring has come in contact with the work.

For the second operation on the brake-drum, the turret is provided with only two sets of tools, as illustrated in Fig. 3. Both sets are identical, with the exception that the tools in one head are adjusted for taking roughing cuts on the surfaces machined, while the tools in the other head are arranged for taking finishing cuts on the same surfaces. Two pilots accurately guide the tools of each head while the cuts are being taken, pilot *F* entering a bushing in the adapter, and pilot *G*, a bushing in an overhead bracket mounted on the headstock. As either head advances, tool *H* bores the internal surface *e*, Fig. 2, of the rim, at the same time that a tool in holder *J*, Fig. 3, turns the outer rim surface *f*, Fig. 2. The finishing head is also equipped with tools for beveling the outer and inner corners of the rim. Edge *g* of the rim is faced by means of a tool mounted on the front of the cross-slide.

The first operation is performed in approximately one-half the time required for the second operation, and so two machines are used for the second operation in order to equalize the production. All three of these machines are tended by one operator.

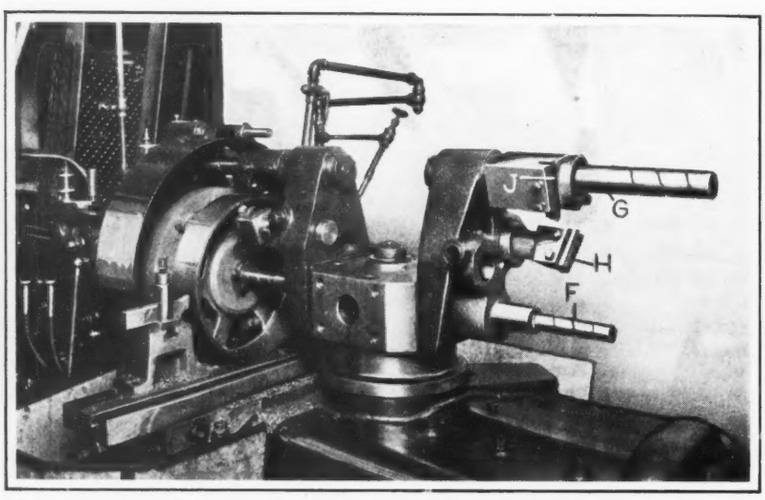


Fig. 3. Tooling Equipment provided for the Second Operation on the Brake-drum

* * *

VALUE OF A MACHINE

The value of a machine used for producing things that are sold in the consumer market cannot be measured by the cost of producing the machine, because its value depends not so much upon what it costs to make, as upon the savings effected by its use in the shop of a manufacturer. Based on this consideration, the prices of most machines used for making goods for the market are extremely low, and the builders of such machines seldom receive a fair compensation for the ingenuity, courage, and enterprise that have made possible the present designs of machines used in manufacturing. The largest returns generally go, not to those who design and build the machines used in the manufacture of what are known as "consumer goods," but to those who produce for, and sell to, the ultimate consumer.

Electric Control Equipment for Large Boring Mill

By W. E. ROSS, Canadian General Electric Co., Ltd., Peterboro, Canada

IN considering the means for controlling a machine driven by a group of electric motors, it is obvious that the use of "general-purpose" starting equipment, wherever applicable, is advantageous from many points of view. One of the most important advantages is the ease with which the starting units of each motor can be assembled at any convenient location to form a complete control station of neat appearance and compact dimensions.

The equipment shown in Fig. 2, which was installed about a year ago at the Peterboro plant of the Canadian General Electric Co., Ltd., for controlling the large boring mill shown in Fig. 1, is a good example of a unit-constructed control station. The boring mill illustrated is said to be one of the largest machines of this kind in the world. The large capacity of the machine is indicated by the following specifications: Actual swing, 36 feet 2 inches; swing with housings moved back nine inches, 40 feet; height under tools, 12 feet; table diameter, 28 feet; and carrying capacity of table, 125 tons. The weight of the table complete with the table gear and spindle is 110 tons. The weight of the cross-rail with the saddles and boring-bars is 80 tons, and the weight of each of the main housings, 26 tons.

The main driving motor develops 75 horsepower, and has a speed range of from 300 to 900 revolutions per minute. It is compound-wound, and operates on 230 volts direct current. The 30-horsepower cross-rail hoist motor, the housing traverse motors, the two 11-horsepower quick-traverse motors, the 1/2-horsepower oil-pump motor, and the four 1/2-horsepower cross-rail clamp motors are all operated on alternating current of 550 volts, 60 cycles.

The large enclosing case shown at the rear of the equipment in Fig. 2 is a non-reversing magnetic control panel for the main driving motor. Directly over this panel is a motor-operated field rheostat for the same motor, while on the pipe framework at the front are arranged the various control devices for the alternating-current motors, as well as the direct-current and alternating-current circuit breakers. Magnetic starting switches are used for the pump motor, quick-traverse motors, and for the primary of the cross-rail hoist motor. For the housing traverse motor, an enclosed magnetic reversing switch is provided, and a special switch of this type is used for each of the four cross-rail clamp motors. This special switch was designed by the engineers of the General Electric Co. at Schenectady, N. Y., and includes a

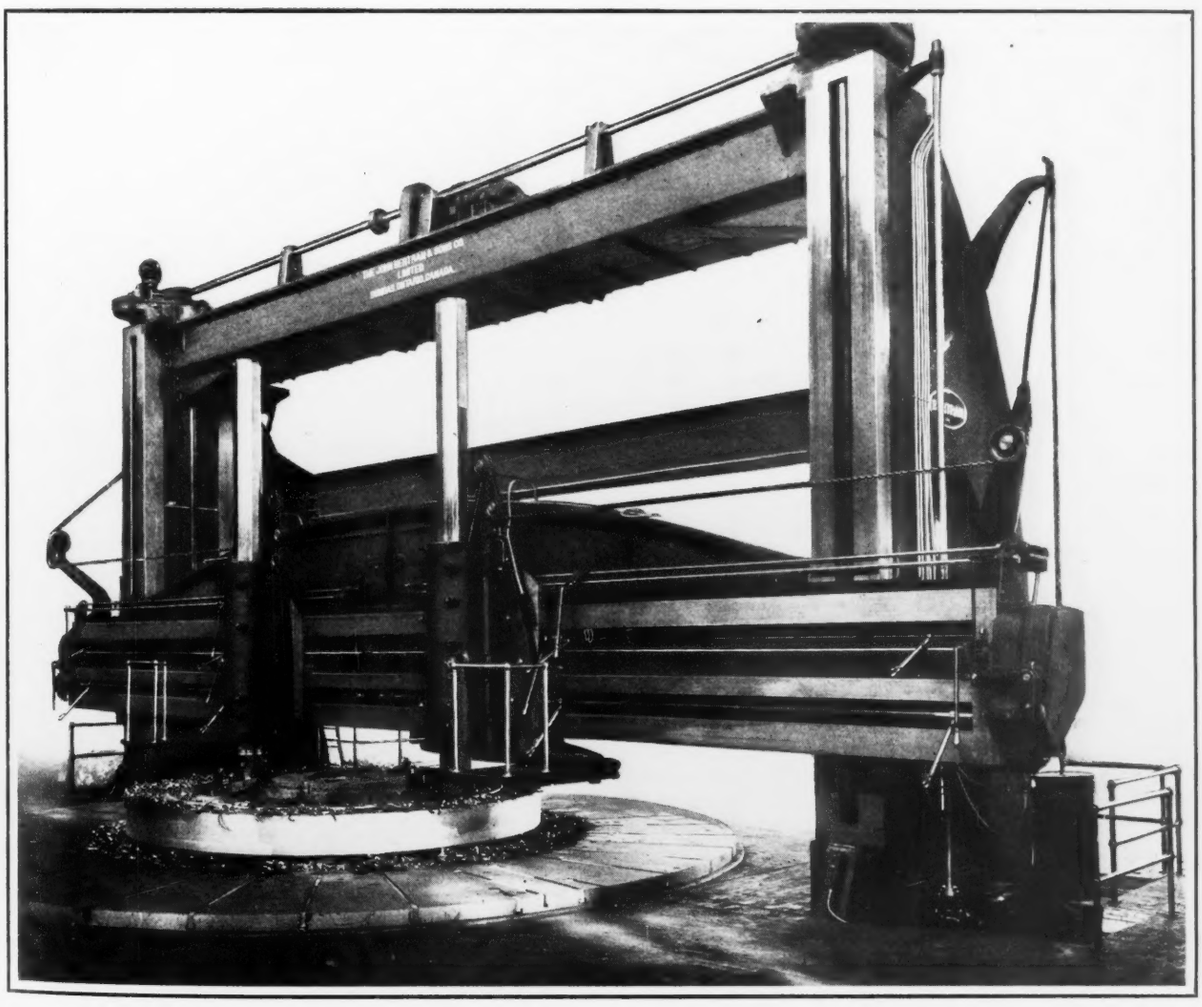


Fig. 1. Large Capacity Boring Mill equipped with Electric Motor Drive

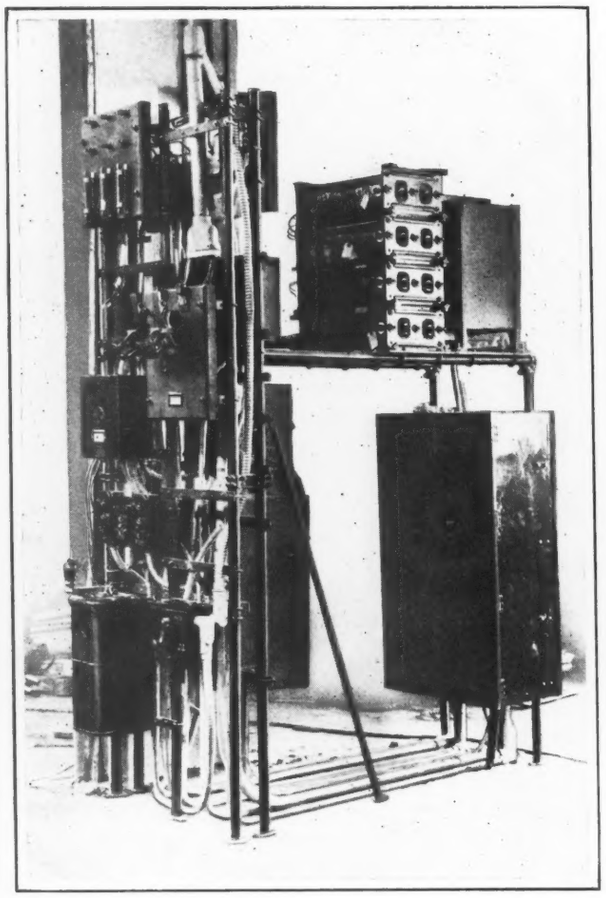


Fig. 2. Electric Control Equipment of Boring Mill shown in Fig. 1

novel and interesting application of a definite time-delay device, which makes it possible to trip off the rail-clamp motors at the end of the travel in either direction without using limit switches.

The rail clamp mechanism is so arranged that the jaw clutch on the motor shaft has an angular idle movement of 120 degrees, and the worm driven from the clutch has an idle linear movement of 1/4 inch between its flanges. As the worm is of 3 pitch, this corresponds to an angular movement of 270 degrees. The total idle movement of the motor shaft is, therefore, 390 degrees, which provides for a hammer blow to the clamp when the motor has rotated this distance and commences to operate the clamp. This arrangement permits the clamp to be driven up tight with full motor torque, and yet leaves the motor free to permit loosening the clamps in the reverse direction.

The setting of the relay was predetermined by the engineers at Schenectady, and it is interesting to note that the setting calculated by them was found to be exactly correct under operating conditions. The operation of the clamp mechanism with the relay setting changed in either direction was found to give unsatisfactory results.

Reference to Fig. 1 will show how the control switches used during actual machining operations are positioned. Push-button switches for "start," "stop," "fast," and "slow" operation of the main motor are mounted at the foot of each standard and on each saddle convenient to the operator's platform. Master switches for the quick-traverse motors are mounted at each end of the cross-rail and connected by shipper rods to splined shafts on which are mounted hand-levers that travel with the saddles.

The push-buttons for controlling the rail clamp motors and the housing traverse motor are mounted on the control board, as these motors are used only in setting up the machine. The cross-rail hoist is controlled by a drum switch with a magnetic starting switch in the primary, the complete control equipment for this unit being located at the control board. The lowering and raising of the cross-rail is of infrequent occurrence, and this fact determined the use of drum control and the location of the apparatus at the control board.

Forced lubrication is supplied to the table track and spindle and all main bearings of the mill by a small oil-pump driven by a 1/2-horsepower motor. To insure the starting of the oil-pump ahead of the main motor, the enclosed magnetic switch for the oil-pump is so connected that it closes immediately upon the closing of the alternating-current breaker, and one pole of the magnetic switch is used as an interlock for the control circuit of the main motor. The main motor, therefore, cannot be started until the oil-pump switch has closed and under-voltage protection on the alternating-current circuit is available for the main direct-current motor.

* * *

DIMENSIONING SMALL TURNED WORK

By HENRY SIMON

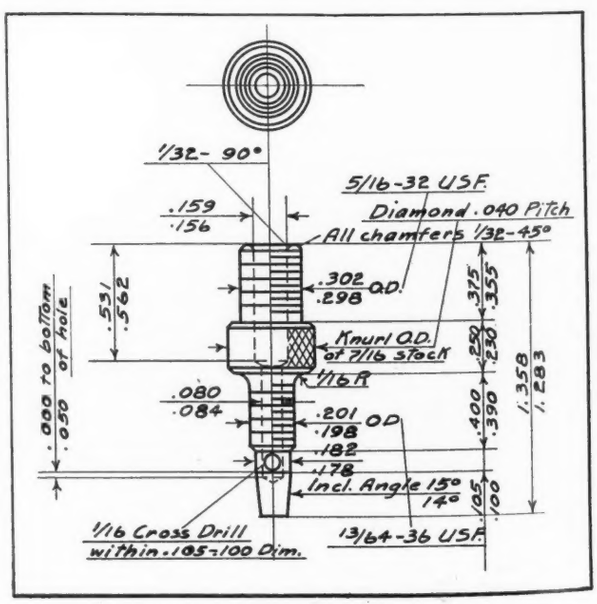
A method of disposing of dimensions that the writer has found advantageous in the case of production drawings for small turned work, such as screw products, is shown in the accompanying illustration. It consists in separating the dimensions for internal and external work, and keeping each kind to one side of the center line, and always to the same side. In the example shown, it will be noted that all internal dimensions are at the left. In some cases, this may cause a concentration of dimensions on one side, but with a little practice, crowding can be avoided in most instances. On the other hand, the method has the following distinct advantages:

1. It is a systematic procedure tending toward uniformity of presentation.

2. It makes checking of the drawing easier, and prevents confusion where external and internal dimensions are close together, as where there is only a small difference between inside and outside diameters and where shoulders inside and outside are nearly in the same longitudinal position.

3. It makes it easier for an operator to find a given dimension and is a help in systematic checking of the product.

A part with more than the usual number of outside dimensions was intentionally chosen as an example. It will be seen that, while in one or two places dimension lines run through figures, which might have been avoided by mixing the dimensions, the drawing is very clear and there is no crowding. And it is a relief to the operator of a battery of busy automatics to know, for instance, that when he has gone down the left side, he has gone over everything that might refer to the internal dimensions of that particular product.



Drawing with Internal and External Dimensions on Opposite Sides of Center Line

SPECIAL WHEEL SHAPES FOR POLISHING

In order to obtain the best results in polishing practice, special wheel shapes are often required, and built-up wheels are used when needed. The wood polishing wheel shown at the left in Fig. 1 illustrates how wheels of this type may be built up. This wheel has a cast-iron hub extending through it, with a loose flange on the opposite side, the loose flange and the flange on the hub being held together by countersunk-head screws, as shown.

The two solid wheels shown at the right in Fig. 1 are types used for polishing skillets and frying pans: These wheels are made from canvas disks. Wheels of this type would be from 7 to 7 1/2 inches in diameter. When in use, the general practice is to revolve the work in an opposite direction to that of the wheel, both the work and wheel being driven separately.

In the upper left-hand corner of Fig. 2, is shown the cushion construction of a compress canvas wheel of the overhanging cup type. The wheel itself is 24 inches in diameter, and has a 4-inch width of face, being designed to accommodate work that may be polished on the side of the

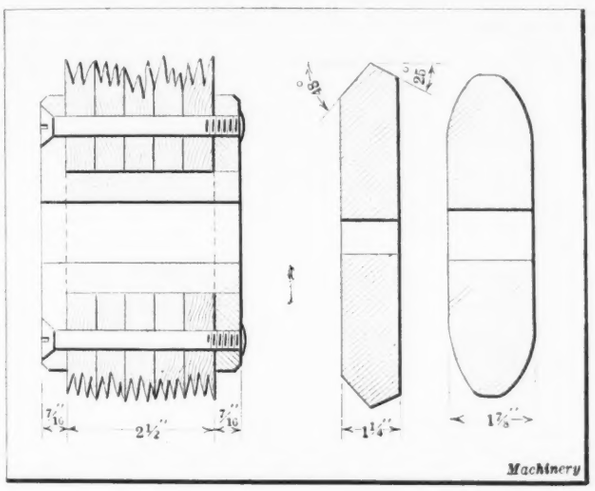


Fig. 1. Sectional Views of Special Designs of Wood and Solid Canvas Polishing Wheels

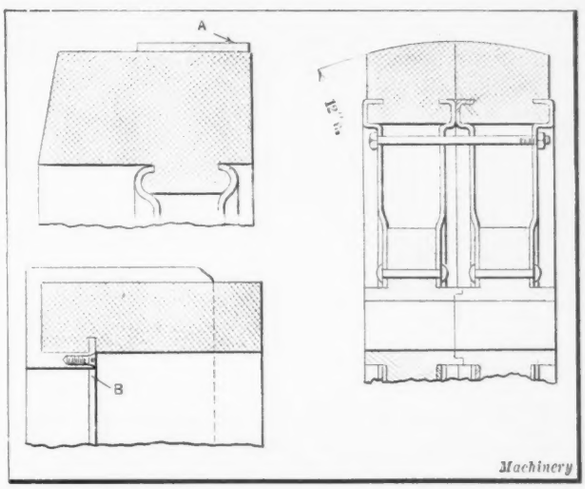


Fig. 2. Special Ring Polishing Wheel Designs, and a Special Built-up Sectional Compress Wheel of Wide Face

wheel but that has some part that extends into the cup. A steel band *A* is employed to reinforce the cushion; this wheel being entirely special in its construction.

The cup-wheel construction shown in the view below has a compress leather cushion. The particular wheel illustrated is 24 inches in diameter, has a face width of 8 inches, and a depth of cushion of 2 1/2 inches. The use of this wheel is similar to that shown above. The special reinforcing ring for this design of wheel is assembled to the leather cushion by means of a 3/16-inch split steel ring *B* which fits into a groove in the cushion. Ring *B* is fastened to the reinforcing ring by screws, as shown. Wheels of this kind are held in an expanding chuck when used, and are commonly used to replace solid ring grinding wheels in flexible grinding operations.

The sectional type of wheel shown at the right in Fig. 2 is made of compress canvas. The wheel illustrated is 20 inches in diameter, has a 6 1/2-inch width of face, and a 2-inch deep cushion. It is representative of the type of wheel used for polishing work with special surface designs, such as is found in stove trimmings.

* * *

What is said to be the largest piece of electrical machinery of its kind ever designed is a frequency changer which has been ordered by the Philadelphia Electric Co. from the Westinghouse Electric & Mfg. Co. This machine, when completed, will weigh more than 600 tons. It will occupy a space 55 feet long, and will be 22 feet high. At a 100 per cent power factor, the motor section of the unit will develop 60,000 horsepower. Twenty-five railroad cars will be required to carry the parts from the factory to the power plant.

SWEDISH IRON AND STEEL INDUSTRIES

According to an article in *Engineering*, reviewing the Swedish iron and steel industry, in the late Middle Ages and up till the end of the eighteenth century, Sweden was the principal iron manufacturing and exporting country in Europe. This leading position was due to the country's wealth in pure iron ore, timber, and water power. The successful introduction of coal and coke into iron-smelting operations, however, immediately challenged Sweden's supremacy, and important metallurgical industries gradually arose in those countries in which mineral fuel and iron-ore deposits occurred side by side.

At one time Sweden was responsible for about 40 per cent of the world's output of iron; this figure has gradually dwindled until it is now just under 1 per cent. Having lost her preeminent position as regards the quantity of her iron and steel exports, Sweden concentrated on the production of very pure materials, and, at the present time, her charcoal irons and high-grade carbon steels are among the purest commercial products obtainable.

Sweden's exports of iron and steel amounted in 1913 to nearly 500,000 tons. Contrary to what might have been expected, the European War dealt a severe blow to the Swedish metallurgical industry; the export trade became very uncertain and, for a time, ceased altogether. Those countries that had relied, to a large extent, on Sweden for the supply of high-grade steels, had to develop their own resources. It was freely predicted that the country had lost her foreign markets completely, and would never be able to regain them when normal conditions were re-established. Subsequent events, however, have shown this to be only partly true: and, according to figures published in a recent issue of *Teknisk Tidskrift*, Swedish exports of iron and steel, which had dropped to 141,000 tons in 1921, have steadily increased in each succeeding year and reached a total of 243,000 tons in 1924. While there is a fairly constant demand for the soft Lancashire and Walloon irons, and the various grades of carbon tool steel, the branch of the Swedish steel industry that has shown the greatest development in recent years is that devoted to the materials for ball bearings. The great progress made by the Swedish ball bearing industry is in a great measure due to the high quality of Swedish steels.

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A series of booklets on the British Empire markets is being published by the Dorland Agency, Ltd., Dorland House, 14 Regent St., London, S.W., England. The first two pamphlets in the series deal with Australia and Canada, respectively. The complete series will consist of eight pamphlets, each one dealing with one important market of the British Empire, giving statistical information of value in the study of that market. The price is $1 for the complete series.

The Problem of Maintaining Production

By J. SETON GRAY, Industrial Engineer, A. O. Smith Corporation, Milwaukee, Wis.

THE real object of a factory's existence must be honestly admitted. Many executives talk a great deal about safety first, and the best possible product that can be made, but the prime reason for being in business is to earn dividends. So long as goods that will meet specifications are produced at a price that will meet competition, the firm remains in business. What are the prime factors that the management must control if quality and price are to be able always to present a distinct answer to competition? It is the purpose of this article briefly to dwell on these factors. It makes no difference whether the product is steel, automobiles, or hosiery, all production problems are practically the same.

Providing the Materials for Production

Material must be on hand to work with in order to produce and the production department must see that every department is furnished with the necessary raw material, or semi-finished product, so that there will be no delay due to waiting for materials. All machines should also be producing, if the best results are to be obtained. Materials and the necessary information in the form of specifications or drawings must reach their destination at the proper time, if the schedules are to be maintained.

Material must never be sidetracked or allowed to get out of the production line. The man in charge of handling or moving material should be able to tell at a glance when certain material should be moved and where it should go. He must be on the best terms with all the foremen and with the production department, as all the departments depend on him for a steady flow of material. If he falls behind in deliveries then all other departments fall behind also. In a large factory, this handling of material assumes tremendous proportions, and the man in charge of this work is actually operating a miniature transportation system. The best man that can be obtained is none too good for this job.

If the product of a factory is to be completed in time for scheduled deliveries, all work must be planned from the time that the material is ordered, so that if any department falls behind, steps can be taken to bring it in line immediately. Building a locomotive or an automobile, for example, involves the finishing and assembling of thousands of pieces. If, for any reason, one piece is behind the schedule, the machines cannot be completed or delivered on time, floor space is wasted in storing materials, the interest on the money invested in the partially completed equipment is lost, and the efficiency of the entire plant is reduced. Failure to meet delivery dates can generally be traced to lack of proper planning and scheduling of the progress of the work through the plant.

Methods of Moving Materials

The ideal means of obtaining production is to have the raw material come in at one end of a line operation, and leave the line at the other end as a finished product. Where there are many operations to be performed, several small lines can be made to feed a main line, and the operations so synchronized that the various pieces will reach the proper destination when required. If these lines can be operated as conveyors, a standard of production is set, depending on the speed of the conveyor. However, conveyors are expensive to maintain and keep in continuous operation. They require considerable power to run, and all product is not adapted to this method of operation. Gravity chutes, which move the product from one operation to another without any handling, provide a cheap, effective way to maintain production speed and eliminate handling charges.

Scheduling and Planning the Work

In order to get the product through a factory on time, all work should be scheduled, so that if any department falls behind, steps can be taken to bring them in line right away. Building a locomotive is a tremendous job, involving the finishing and assembling of thousands of pieces. If, for any reason, one piece is overlooked, it means that the completed locomotive will stand around waiting, taking up valuable floor space, and waste the interest on the money invested in it, when, if the production had been synchronized throughout the factory, the completed locomotive would have been delivered, the money placed to the credit of the company, and the space been available for other work.

Failure to meet delivery dates can generally be traced to the lack of proper planning on the part of the planning department or the departmental foreman. There is no job so disliked by a salesman as being compelled to notify customers that the delivery date cannot be met. It puts him in a bad light, and when he tries to get business again, his promises of delivery are discounted. A great deal of business is placed with the firm that can promise the best delivery. When these delivery dates are not met, due to failure of the factory organization in proper scheduling, the effect is far-reaching and may determine, at a later date, who will get business that is badly needed in order to keep the factory running to capacity.

When a schedule has once been determined, no alterations should be permitted, as there is nothing that upsets an organization more than being held up while changes are being made, especially if the shop happens to be working on piece-work. The total production is bound to be affected by changes, because as the job gets under way, the rate of effort gradually increases, due to familiarity with the job. If anything happens to upset this, you can expect it to show in decreased production.

Where a great many operations are performed in many different departments, it is advisable to arrange the work so that the production of the various departments is synchronized. There is nothing to be gained by having one department produce twice as fast as another, when they are both feeding the same assembling department. The ability of this latter department to absorb the product of other departments depends on the help and equipment available. The last operation performed controls the factory production, and no department should be allowed to get out of step with other departments, unless it is planned that it should be shut down while the others catch up.

Cooperation between Production Department and Foremen

In order to maintain a successful production schedule, there must be cooperation between the production department and the departmental foremen. The foremen must report progress from time to time, and notify the production department immediately, if there is a hold-up, so that the necessary steps may be taken to clear obstructions and devise some means whereby the schedule may be maintained. This is especially true in the furnishing of tools, which is generally the reason why many schedules fail.

Centralizing the responsibility for all production in the production department gives a direct control of the output,

as the personnel of the production department acts as the "go between" of the different departments. It often happens that one foreman feels he does not want to take what he thinks are orders from another foreman, but if these orders came direct from the production department, there is no logical reason why action should not be taken, as all instructions regarding production emanate from the same source.

Keeping Tools and Equipment in Good Condition

In order to meet production requirements, tools and equipment must be kept in shape at all times. It is not sufficient to have a repair gang on hand that will take care of breakdowns; they should also be responsible for preventing breakdowns and should carry sufficient spare parts so that when breakdowns do occur, the equipment will be out of commission a minimum length of time.

Failure to meet delivery dates is more often due to tools not being ready than to any other cause. It takes time to manufacture tools, and if the tool-room is not given a sufficient length of time to prepare these tools, it cannot be expected that the schedule will be maintained. When tools are not forthcoming, departmental foremen who are looking for them will start their work without these tools, which increases the cost of production and generally means closer supervision on the part of the inspection department, as hand operations cannot be depended on in the same way as work that is performed by tools.

The Responsibility of the Foreman for Production

As a general rule, production foremen feel that the inspection department is responsible for all inspection, and that when a set-up or run has been passed by the inspector, they do not need to pay any further attention to it. A foreman is responsible for all product that passes through his department, regardless of whether it has been OK'd by the inspector or not, and on long runs especially, he or one of his representatives should check up from time to time to see that all specifications are being complied with. There is too much buck-passing and blaming the inspectors for work that falls below specifications, when it is really the departmental foreman who is responsible.

Putting New Ideas into Production

The average man does not relish changes, and does not like to have to work in a different way from that in which he has been in the habit of working, unless he fully realizes and appreciates the advantages of the new method. New schemes for getting out production are generally in the hands of experts or engineers, and these men must show rare judgment if they expect to receive cooperation from the men in the shop.

Many high-class foremen object to outsiders working in and around their department, feeling that their presence interferes with production. When new ideas are suggested, they want these ideas to pass through their hands, so that they can take the necessary steps to put them into practice. The use of one-sided specialists in a factory is commendable, but good judgment must be shown if the best results are to be obtained. The average foreman feels he knows more about his job than anybody else, and within certain limits this is correct; he resents as an intrusion the presence of a specialist who, he believes, knows very little about his job.

Watching out for Excessive Spoilage, Scrap and Waste

In the operation of any factory, there is necessarily a certain amount of wastage and spoilage. Wastage is material that is unavoidably destroyed in the process of manufacturing, but steps must be taken to keep this wastage down to a minimum. Scrap must be watched closely, and the pieces scrapped must be replaced. Just as soon as the inspection department scraps anything, the production department must be notified, so that replacements can be made immediately.

The unit cost of any product decreases as the quantity of production goes up; but over-speeding, especially by men on piece-work, must be watched closely, as in such cases quality is often forgotten in thinking about quantity. The workers should be given to understand that all work rejected must be replaced; only work that will pass inspection will be paid for.

The running time of equipment should be watched closely, and idle machinery and equipment reported to the production department. In one factory where there was a great deal of small lathe work, one department was so overcrowded that it was impossible for it to meet the schedule without working a great deal of over-time. This condition had been going on for several weeks before it was discovered that another department had idle lathes that could do the work. Transferring some of the work from one department to the other enabled both departments to keep busy, and the schedule was maintained without the use of over-time.

It should be possible to obtain the necessary production during the regular day's run, and not make a habit of working long hours. A man can stand the strain of extra hours for a limited time, but after that his productive effort decreases. Should it be found necessary to work longer hours in order to maintain the production schedule, it is best to put on a double shift, even when this may call for a night shift on one or two operations only. Over-time can be excused for a short time, but over a long period it becomes quite costly. It costs more per hour in wages, the effort per hour is reduced, and the possibility of accidents greatly increased.

When a great many operations are performed in different departments, it is necessary to see that the work in all the departments is synchronized so that they all produce at an equal rate. There is nothing to be gained by having one department produce twice as fast as another, if they are both feeding the same assembling room. The ability of the assembling department to absorb the products of other departments depends on the help and equipment available, and it is the capacity of the assembling department that should control factory production; no department should be allowed to get out of step with it. The coordination of different departments is usually much more difficult than the problem of managing each individual department as a unit.

Effect of Wages on Production

Good results cannot be expected unless the men receive equitable compensation for their labor. A man generally gets what he pays for, and he cannot expect good workmen to work for a low rate of pay. Generally the firm that is paying best attracts the best workmen, as it is understood that greater effort must be put forth in order to earn greater compensation. It is only within late years that it has become understood that greater pay means greater production, as the men know that there are many men besides themselves who are on the lookout for the better paid jobs.

Selecting the Right Man for the Job

The workman must be suited to the work he is asked to perform if the best results are to be obtained. On a certain job, where it was necessary to wheel a great deal of concrete, it was noticed that the tall men spilled a part of the load before reaching its destination, due to the angle at which they had to hold the wheelbarrow when walking. When shorter men were put on the job, practically no concrete was spilled during the wheeling process. This is of importance in all lines of work. If a man is too short for the bench on which he is working, give him a platform to stand on, or a lower bench; in any case, if the best results are sought, the workman must feel at ease. There will also be a decrease in efficiency if work is done on machines not adapted for the purpose.

A man will do more and better work in a factory where the surroundings are congenial. If efforts are made to care for the machinery and equipment, if the aisles and passageways are kept clean, if an attempt is made to acquaint him with his surroundings when he starts working, he will feel contented and work to better advantage.

SEDIMENT AND WATER IN FUEL OIL

By C. C. HERMANN

When fuel oil is purchased in tank cars, some specification should be made regarding the permissible sediment and water content. Oil containing an excessive amount of sediment and water causes no end of trouble in the factory; burners, screens, and pipes become clogged up, and pump elements are needlessly worn out. Production also lags, as a result of poor burner action. Water in the oil causes the burners to sputter and the flame to become extremely vibratory. In some instances, the water even causes the flame to be extinguished. Under such conditions, the stock will not be heated uniformly and the operator's attention is demanded by the burner, to the exclusion of the productive work.

Sand is nearly as troublesome as water. It fills up the screens, and shuts off the flow of oil to the burner. Unless the screen is very good, the sand finds its way into the burner, clogging up the port and wearing out the valve. In order to clean the ordinary valve, it must be removed from the furnace, and this causes a further loss of time and often requires the assistance of a plumber.

It is obvious that specifying the maximum amount of sand and water permissible in the fuel oil is a sound business policy. The problem of determining whether or not oil meets the specifications in this respect is, therefore, of considerable importance. In fact, it is the only means of insuring against a shut-down, which invariably follows the receipt of an "off" car that sometimes finds its way to the consumer.

Settling of Sand and Water

Sand and water will settle to the bottom of the tank if the car is allowed to stand still for a short time. When in transit, the sand and water become mixed with the oil, and for this reason, the car should be allowed to stand on the company's siding for a short time before unloading. As two days are allowed in which to unload a car without being subject to demurrage, and since unloading requires only a few hours, this practice may be employed. Of course, there are times when a car is received just in time to prevent a shut-down, and in such a case as that, it cannot be allowed to stand on the siding.

It is advisable, whenever possible, to determine whether or not the oil contains dirt and water before it is unloaded. If this is not done, it is difficult to make a fair price adjustment. A tank car that is not up to requirements should be left on the siding, whenever possible, until some satisfactory adjustment has been agreed upon.

Testing Oil for Sediment

In order to obtain a proper adjustment, it is necessary to determine the amount of sediment or water in the oil. To detect sediment, a cup is attached to a long pole and dipped into the bottom of the tank. The cupful of material is then examined for sand and gritty substances. If the specifications read (as they should) "Only a trace of sand, clay, or dirt permissible," and a whole cupful is brought up, it is obvious that the shipment does not meet the specification, and the seller should be notified immediately.

Method of Detecting Water

In order to determine whether or not the oil contains water in excess of, say, 2 per cent, the oil in a tank car should be sampled immediately upon its arrival. This is done by taking a cupful of the fluid from as deep down in the tank as possible. A tablespoonful of this sample is held above a Bunsen burner until it reaches the boiling temperature of water. If it boils, that is, if the liquid becomes visibly agitated, this is a sure indication that the oil contains considerable water. Oil will expand when heated, but does not boil. Water in the oil, however, causes a boiling action to take place.

Another method of testing oil for water is to allow the tank car to remain on the siding long enough to permit any water it may contain to settle to the bottom of the tank. What is known as a "water detector" is then attached to a metal strip, and dropped to the bottom of the car. The water detector is simply a piece of sensitized paper that changes its color when immersed in water, but retains its original color when oil only is present. After removing the detector, the exact depth of the water at the bottom of the car can be determined, and the volume calculated. This information should be wired at once to the oil company, and the reply should be received before the car is unloaded.

It is obvious that the excess sand, clay, dirt, and water should be deducted from the total content of the car. The remainder thus obtained represents the amount of oil to be paid for. When the oil company accepts the test as conclusive, and the car is to be unloaded, the next problem is to prevent any of the undesirable elements from being carried into the storage tank. It is also necessary to determine the amount of objectionable matter, in order to calculate the net amount of oil to be paid for.

The sand may be separated from the oil by placing fine-mesh strainers in the unloading pipe line. The unloading is somewhat delayed by this procedure, but this precaution is well worth the extra time required. The strainer must be cleaned occasionally, and this requires the closing of the car valve, unless an automatic self-cleaning strainer is employed. The sand and sediment should be placed in barrels and weighed after the car has been unloaded.

Removing Water from Oil

After the water has settled to the bottom of the tank, a valve located at the lowest point in the tank may be opened allowing the water to run out on the ground. When this procedure is followed, the detector method of measuring the amount of water in the tank is depended upon in making adjustments. A more accurate method, however, is to allow the water to run into barrels. The amount of water in the barrels can be easily measured, and this serves as a check on the amount shown by the water detector method. The change from water to oil can easily be determined by the difference or change in the color of the stream flowing from the tank. Of course, there will be a slight loss of oil or else some of the water will be retained in the oil when the connection is made to the storage tank.

Disposition of Sediment

The question often arises as to what should be done with the sand and water obtained from the tank car. Obviously there is a small amount of oil in the sediment. The water may as well be dumped out at once, as the amount of oil contained in it is practically negligible. The writer has poured the waste oil and sediment over coal and sawdust that was to be burned in the boiler room. The sand and dirt works down through the grate with the ash, and some heat is obtained from the oil. The objection to this practice is that the oil thus burned forms a heavy soot over the heating surface of the boiler, which must be removed in order to maintain efficient operation.

* * *

AUTOMOBILE EXPORTS

A truly remarkable achievement of American industry in 1925 is the increase of nearly 60 per cent over 1924 in the number of automobiles exported, raising the automobile to a rank in our export trade surpassed only by cotton and mineral oils. Every indication is that this remarkable advance will continue, largely because of the general improvement of world economic conditions, the lowered prices of our automobiles, the inability of most European producers to satisfy demand, and the exploitation of hitherto undeveloped markets, stimulated in several important instances by the Department of Commerce. Outstanding examples of increased purchases of American automobiles in 1925 over 1924 are: Belgium, 36 per cent; Denmark, 700 per cent; Norway, 30 per cent; Brazil, 154 per cent; and the United Kingdom, 260 per cent.—*Julius Klein, director of the Bureau of Foreign and Domestic Commerce.*

Tooling Production Milling Machines

Description of Work-holding Fixtures and Cutters Designed to Give High Output Rates with Standard Machines

THE mere purchase of a machine tool for use in the quantity production of some part seldom solves the problems of the operation for which the machine is intended. Work-holding fixtures and jigs must usually be developed in addition, and the design and size of cutters determined. Most machine tool builders have made it a part of their business to plan methods of performing operations and build the work-holding devices required, as a service to their customers. In the following will be described a number of milling machine set-ups developed by the engineering service department of the Cincinnati Milling Machine Co., Cincinnati, Ohio.

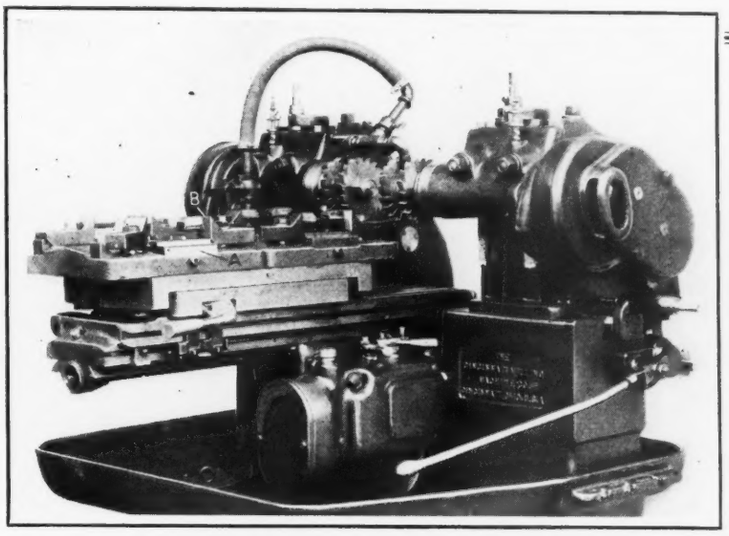


Fig. 1. Automatic Milling Machine equipped for milling Two Sides of Small Forgings

Fixture with Simple Swivel Clamps

In Fig. 1 is shown the tooling equipment provided on a duplex automatic milling machine for milling two sides of small steel forgings. A fixture holding four pieces, two in a row, is mounted on each end of an indexing base. The work pieces are laid on blocks *A*, and secured in place by swiveling clamps *B* to exert a pressure on the top of the pieces. Each of the clamps is locked in position by means of a spring-actuated pin in the end opposite to that which exerts the clamping pressure. This pin engages a groove in the sloping surface of a small block attached to the fixture.

While four pieces in one fixture are being fed past the cutters, four more pieces can be reloaded in the other fixture. The fixture base indexes automatically at each return of the work from the cutters, after which the table again advances to carry the rough work past the cutters. About 1/16 inch of stock is removed from the two surfaces milled. Two cutter gangs are used, each of which consists of two side mills and one spiral mill. In order to eliminate the necessity of grinding both spiral mills to the same diameter, which would be required if they were mounted on a single arbor, each cutter gang is mounted on a separate stub arbor. This permits an independent vertical adjustment to take care of variations in the diameters of the spiral mills. The side mills are 5 1/2 inches in diameter. The table feed is 5.1 inches per minute, and the average time per piece is 0.37 minute. One of the features of this equipment is that six different sizes of work can be accommodated merely by changing the locating blocks seen at *A*.

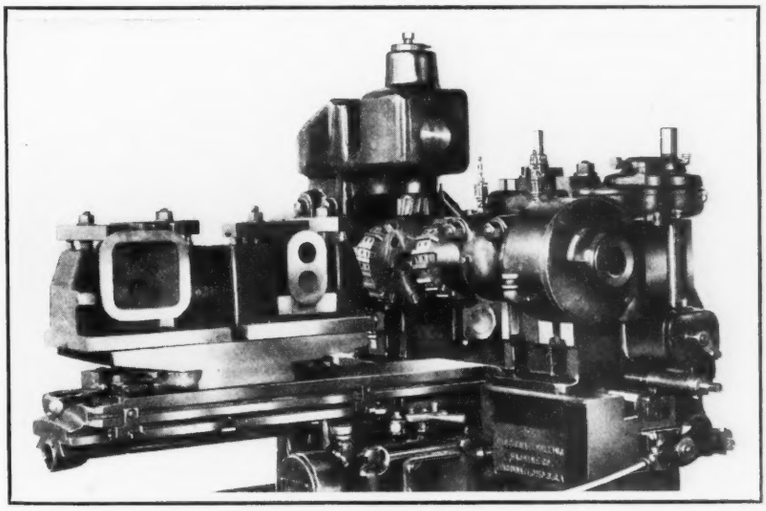


Fig. 2. Machine equipped with Two Horizontal and One Vertical Cutter-spindle for milling Air Compressor Cylinders

Set-up for Milling Air Compressor Cylinders

Top, bottom, and side flanges of a cast-iron air compressor cylinder are milled by means of the equipment shown in Fig. 2. Approximately 1/8 inch of stock is removed from each of the three flanges. For this operation, the left-hand side of the machine is equipped with a special head containing a vertical cutter-spindle, in addition to the regular horizontal spindle. The cutter of the vertical spindle mills the small flange on one side of the cylinder, while the face milling cutters held in the regular spindles mill the top and bottom flanges of the casting.

One casting may be held in each of the two fixtures mounted on the standard indexing base, which permits reloading the work in the fixture that happens to be in the outer position while the operation is being performed on the other casting. The two inserted-blade face milling cutters are 8 1/2 and 7 1/2 inches in diameter, respectively, and the shell end-mill is 3 inches in diameter. The table feed is 5.1 inches per minute, and the production averages one casting every 1.7 minutes.

Fixture Having a Cam-operated Clamp

The tooling equipment shown in Fig. 6 is used for straddle-milling the large end of small drop-forgings. Two of the parts are shown on the table to the right of the work-holding fixture. About 3/32 inch of stock is removed from each side of the parts. The fixture holds two pieces abreast in the horizontal position. Each is set on a flat fixed support, located under the portion to be milled and is lined up by a spring-supported vee under the round shank. The end pressure is taken by a fixed support behind the shank. A hinged clamp *A* is operated by lever *B* to hold the work in place. The work is fed straight into the gang of four side-mills, which are 4 3/4 inches in di-

ameter, a large supply of cutting lubricant being used in the operation. The average time per piece is 0.23 minute. It will be observed that all four cutters are mounted on one arbor, which is driven from the left-hand end and merely supported at the right-hand end.

Milling Storage Battery Pole Pieces

Fig. 3 shows the equipment provided on an automatic milling machine for milling storage battery pole pieces, four at a time. The parts are made of mild steel and are straddle-milled on the large end, as may be seen at *A*. A small angular groove (not discernible in the illustration) is milled in the same end of each part. It is necessary to produce a particularly good finish on the flat surfaces in order that good electrical contact may be obtained when the parts are placed in service. Four pieces are held abreast in each of the two fixtures, and

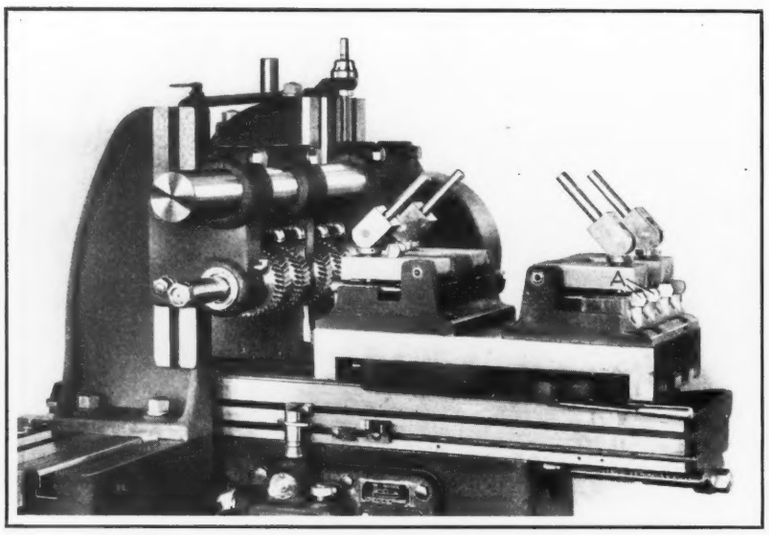


Fig. 3. Tooling Equipment used in straddle-milling Four Storage Battery Pole Pieces

are located by seating the turned surfaces in V-blocks. Cam-operated clamps of the same design as that used in the example just described, are employed in this case for clamping two pieces at a time. The V-blocks are removable to provide for milling different shaped pieces, and there is an adjustment on the cam clamps to take care of different diameters of work. The operation is performed by feeding the work pieces directly into the cutters.

The main cutters are of the side-mill type, with angular teeth, while the angular groove in the work is milled by a smaller angle cutter mounted between each pair of side milling cutters. To avoid any possibility of the cutters chattering due to the arbor springing under the cut, a central arbor support is added. This support is of the cap type, that is, the bearing is split in such a way that the support can be conveniently swung out of the way to facilitate removing or replacing the gang of cutters. The side-milling cutters are 6 inches in diameter, and the special angle cutters, 4 inches in diameter. A feed of 1 5/8 inches per minute is used in this operation, and the time per piece is 0.243 minute.

The machine shown in Fig. 7 is employed for milling the sides of crankshaft bearings and an oil-slinger groove in a combined automobile cylinder and crankcase casting. The casting is seated on a finished valve side pad, with the finished bottom extending forward. Two dowel-pins in an angle-plate at the front of the fixture locate the casting sideways. Strips under the valve side pad serve mainly to support the casting near the top of the cylinder block, and a pair of rails facilitate sliding the work to and from the angle-plate. At the right-hand end of the fixture may be

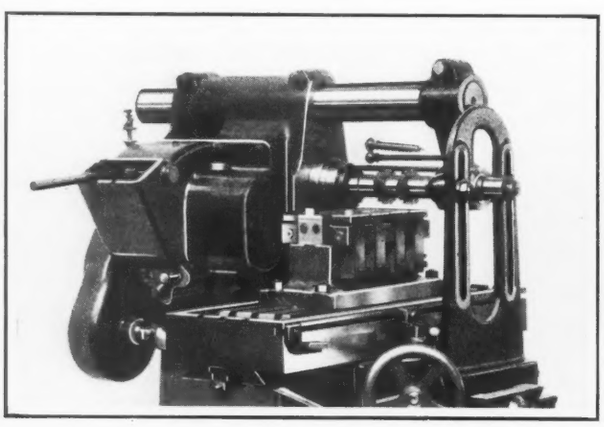


Fig. 4. Fixture provided with Eight Equalizing Clamps operated by Four Screws for holding Sixteen Pieces

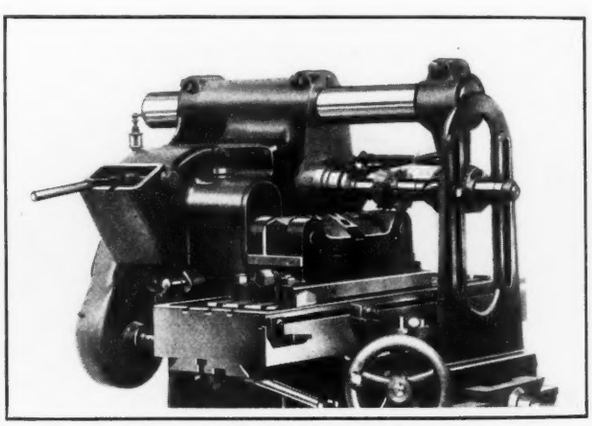


Fig. 5. Another Equalizing Clamp Type of Fixture in which Twenty Pieces are tightened or loosened by turning One Screw

seen two cam-operated clamps, which are used to secure the work firmly in place.

The cutter-arbor of this machine is supported at the outer end in a special cap-type fixed-height tailstock, and in addition, a central support is provided. The latter is bolted to a bridge which extends over the table from the head to the tailstock. The cutter-arbor is of a special type having a cylindrical pilot end in place of the ordinary taper shank. The end location of the arbor is effected by clamping the arbor driving flange directly against the end of the spindle nose. This permits the cutter gang to be set on an arbor using the driving flange as a primary location point, and eliminates the need for lateral adjustment of the headstock when cutter-arbors are changed. The regular overarm of the machine is omitted, because it interferes with the work. Six side-milling cutters, 6 inches in diameter,

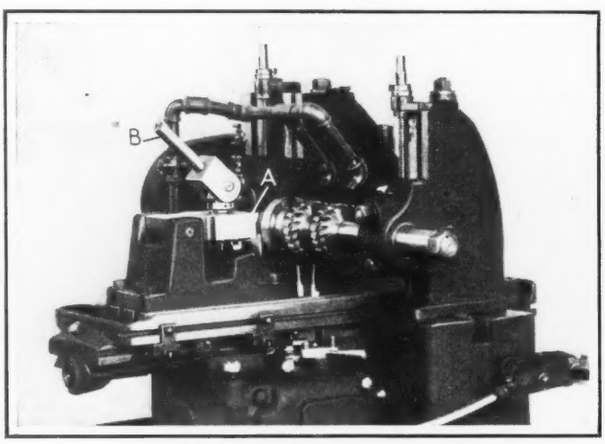


Fig. 6. Fixture provided with a Quick-operated Cam Clamp

are used for this operation, 1/8 inch of stock being removed from the different surfaces at a table feed of 2.65 inches per minute. The time per piece is 1.57 minutes.

Equalizing-jaw Type of Fixtures

Small pieces of alloy steel, 1 3/8 inches long by 1/2 inch wide by 7/16 inch high, are milled on top to a radius of 3/4 inch by means of the equipment illustrated in Fig. 4. About 1/16 inch thickness of stock is removed. The special vise fixture shown on the table of the machine holds sixteen pieces at one time, in two rows of eight each. The work pieces are supported on a fixed plate, and clamped sidewise against a fixed jaw. The hinged clamps on the opposite sides of the fixture are equalized, only four screws being operated to tighten or loosen the clamps. Each clamp holds two pieces. The cutters are 3 1/2 inches in diameter, and the feed of the work is 0.100 inch per revolution of the cutters. The time per piece averages 0.15 minute. A large amount of cutting lubricant is supplied during the operation.

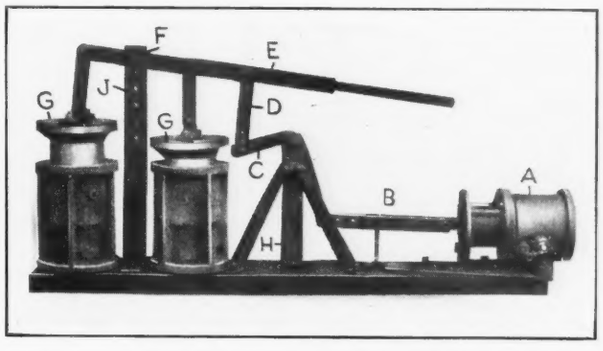
In the operation illustrated in Fig. 5, small alloy steel pieces, 1 5/8 inches wide by 1/2 inch thick, are milled on top to an inverted vee. One of the pieces is shown on the table near the left-hand edge of the fixture. Twenty pieces are held in one row in the special fixture, being stacked face to face and clamped by merely tightening one screw. This screw engages a tapped hole in a swivel clamp at the left-hand end of the fixture, and contacts with a long rod that extends through the base of the fixture to actuate a similar swivel clamp at the right-hand end. A stationary block extends across the fixture near the middle, and the pieces of work are gripped between this block and the swiveling clamps at the two ends. Two V-supports beneath the work and a fixed side plate serve to locate the pieces. About 1/16 inch of stock is removed in the operation by two 4-inch cutters. The feed is 0.071 inch per cutter revolution, and the production time is 0.105 minute per piece.

* * *

GRINDING STEAM PIPE EXPANSION JOINTS

By E. A. MURRAY, Shop Superintendent,
The Chesapeake & Ohio Railway Co.

Steam pipe expansion joints are used on all engines of the Mallet type, and the joint grinding device shown in the illustration doubtless will be appreciated by those interested in the repair of locomotives of this type. In some instances, these expansion joints are packed with fibrous packing, but this packing is not durable enough to withstand high steam pressures; consequently, metal packing rings are being applied at the Huntington Shops of the Chesapeake & Ohio Railway Co. These metallic rings are ground to obtain a good bearing in the expansion joint sleeve, by means of an air-operated device.



Air-operated Device for grinding Metallic Packing Rings of Steam Pipe Expansion Joints

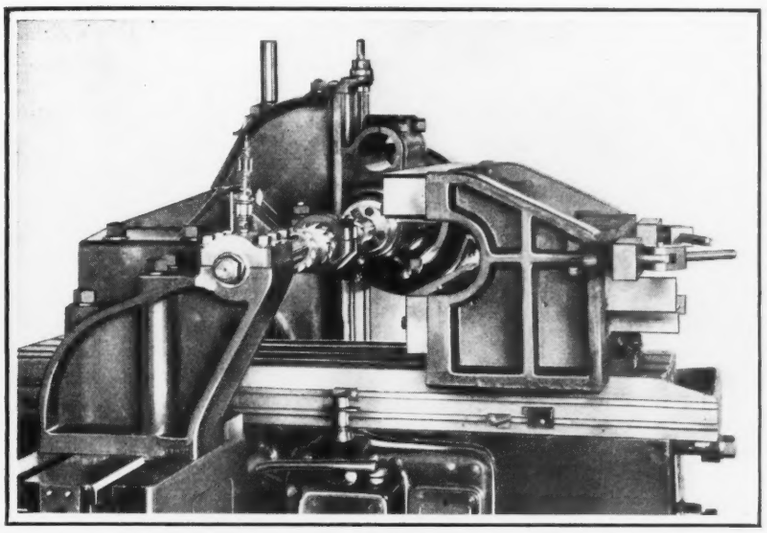


Fig. 7. Milling the Sides of Crankshaft Bearings and an Oil-slinger Groove in a Combined Cylinder Block and Crankcase Casting

Power is derived from a 9 1/2-inch Westinghouse air pump *A*. The piston-rod of this pump is connected by link *B*, bell-crank *C*, and link *D*, with rocking lever *E*, which is pivoted at *F*. As this rocking lever moves up and down, it imparts a vertical movement to the internal sections of the expansion joints. Two of these joints *G* are ground at the same time. Oil is used to give the packing rings a smooth finish, but an abrasive is not required. This machine was designed by J. Lewis, gang foreman. It will grind two expansion joints in thirty minutes.

Some idea of the size of this joint grinding machine may be obtained from the following general dimensions. The base is formed of a 15-inch channel, 8 feet long. The length of link *B* (center-to-center distance between holes) is 23 3/8 inches. The long and short arms of bellcrank *C* measure 15 3/4 and 11 1/4 inches, respectively. Fulcrum *H* is 24 1/4 inches high, and fulcrum *J* 38 3/4 inches high, measuring to the top hole. The center-to-center distance between the expansion joints is 21 inches. Lever *E* is provided with an extension for hand operation, which is often convenient in entering the packing ring and placing the joint into position for grinding.

* * *

MACHINERY IMPORTS OF INDIA

According to information obtained by the Department of Commerce from Consul William L. Jenkins of Calcutta, India, the total value of machinery imported into British India in 1925 was nearly $54,000,000, as compared with somewhat over $46,000,000 in 1924. Of the imports in 1925, by far the largest part—$43,750,000 worth—came from the United Kingdom. Second in importance were the imports from the United States, valued at $4,846,000, as compared with $4,705,000 in 1924. Germany ranked third with imports into India valued at $2,665,000. It is worthy of note, however, that this volume was almost double the volume in 1924. Of the British India imports, $1,489,000 represented machine tools in 1925, as compared with $1,301,000 in 1924. The largest group of machinery imports was textile machinery, which was imported to a value of nearly $13,000,000.

* * *

The toll of industrial accidents still runs very high in spite of the great efforts that are being made to reduce avoidable accidents. The Pennsylvania Department of Labor and Industry has made public a report for the past year, showing that accidents in the industries during the year have caused the loss of 97 legs, 73 arms, 190 hands, and 538 eyes in Pennsylvania alone. Reports of this kind emphasize the great need of taking every possible precaution in all industrial undertakings. If the employer provides the proper safeguards, the worker should cooperate by using them.

REPAIRING ALUMINUM ALLOY CASTINGS BY SOLDERING

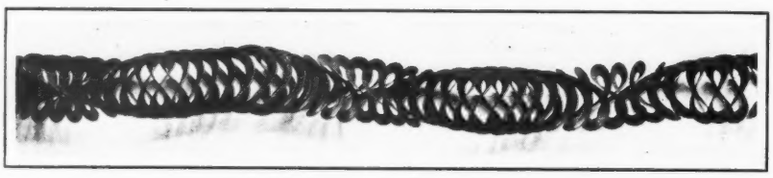
By E. DARWELL

The article entitled "Repairing Aluminum Alloy Castings by Soldering," which appeared on page 485 of February MACHINERY, shows that fractured and defective aluminum castings have been successfully repaired by soldering—a method that only a few years ago was considered by many mechanics and engineers to be impracticable. With the increased use of aluminum and aluminum alloy castings, there has developed a greater need for making repairs on fractured and porous castings by the soldering method.

Requirements for Oxy-acetylene Welding

Although the oxy-acetylene process is generally satisfactory in making permanent repairs on aluminum alloy castings, experience has shown that there are many cases in which it is not permissible to heat the parts to the high temperature required for this process, namely, 6300 degrees F., because of the attendant distortion. As the composition of aluminum alloys is extremely variable, it is difficult to obtain a truly homogeneous weld. To insure obtaining a perfectly sound weld, it is necessary for the welding material to be of exactly the same composition as the casting to be welded.

Unfortunately, many welders use pure aluminum as the filling in material—a practice not to be recommended, because if an alloy containing, say, 10 to 15 per cent of zinc is being welded, its melting point will be approximately 100 degrees F. lower than that of the aluminum, the result being increased difficulty in making the weld and a lack of soundness in the welded joint. Moreover, the casting will be almost certain to fail if the metal is too soft along the line of the weld.



Unusual Chip turned from Heat-treated Chrome-vanadium Steel Bar

In soldering aluminum alloy castings, the composition of the casting need not trouble the operator if he has a good solder and efficient equipment. Any skilled workman can make a successful repair by soldering, if instructions are carefully followed. The necessary equipment, in addition to the ordinary bench tools, consists of an atmospheric gas torch and tubing, or a kerosene blow-torch, files, scrapers, jigs, clamps, etc. Care must be taken during the manipulation of the gas torch not to employ too great a heat; otherwise, a useless or inferior joint will result, and the casting may be spoiled.

Advantages of Soldering

Some of the advantages gained by soldering may be summarized as follows: The cost for repairs is less; preheating is unnecessary; no flux is required; and there is practically no distortion or warpage of the work. In making welds, the flux required to make the joint often has a detrimental effect on the metal. On no account should zinc chloride be used in fluxes for soldering aluminum alloys, as a certain amount of the zinc is reduced from the flux and becomes alloyed with the metal. The time saved in soldering is also an important factor, especially for such work as closing small holes and cracks in castings. In many instances, repairs on such work can be made without dismantling the assembled parts, which would be necessary if repairs were made by welding.

Before proceeding further, the writer desires to state that he is wholeheartedly in agreement with the following statements that appeared in the article referred to in February MACHINERY: "In many cases, failures in soldering aluminum alloy castings can be traced to incorrect regulation of the heat used in making the joint. It is a mistake to think of soldering aluminum as being the same process as that which the ordinary tinsmith uses in soldering tin and copper with a hot copper bit and a solder that will flow and follow the copper." Aluminum and aluminum alloys are not soldered that way. A higher degree of heat is required to solder aluminum and aluminum castings than can be conveyed by means of the ordinary soldering bit. For ordinary tinsmiths' soldering operations, a temperature of not more than 400 to 450 degrees F. is required, but for soldering aluminum or its alloys, a temperature of from 550 to 650 degrees F. is needed.

Tinning Parts to be Soldered

As success in repairing aluminum alloy castings by soldering depends mainly on the thoroughness with which the parts to be joined are tinned, considerable attention should be given to this process. Failure to make the solder adhere readily to aluminum or aluminum alloy castings may be due to two causes, namely, poor quality of the aluminum alloy or a carburized metal surface. A carburized surface is invariably caused by a partly luminous and smoky flame from the gas torch or the kerosene blow-torch. In either case, the surface of the casting must be cleaned before attempting to retin the metal, as a clean surface is an important factor in making a successful joint.

All parts to be soldered must be carefully supported in order to prevent any movement while the joint is being made. There are many aluminum solders on the market that give good results on aluminum alloy castings, when they are not subjected to excessive vibration, such as found in automobile service or when they are not exposed to severe atmospheric conditions. Soldered joints that are subjected to adverse atmospheric influences should be protected by suitable paint or varnish. A good aluminum paint will often afford a permanent protection to a soldered joint and give a bright finish as well.

Aluminum solders consist chiefly of an alloy containing several metals in varying proportions. The metals used are tin, zinc, aluminum, cadmium and phosphor-tin. Some recently patented aluminum soldering processes employ twin solders—one solder for tinning and to make the joint, and the other to serve as a protecting cover for the joint. The second solder, when applied after making the joint with the first solder, produces a joint that is impervious to atmospheric conditions and electrolytic action.

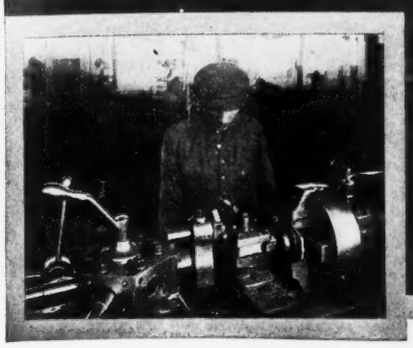
The alloy solder used for tinning and making the joint should have a high mechanical strength, be easy to work, and be free from phosphorus. Unfortunately, an alloy that meets these requirements will not resist the effect of moisture or boiling water, largely on account of the electro-positive nature of the aluminum and the metals that must be employed to form the alloy. The second or protective coating alloy has a lower melting point than the first, and while it alloys freely with the solder employed to make the joint, it has a higher resistance to electro-chemical action and to the effect of moisture, boiling water, and even steam.

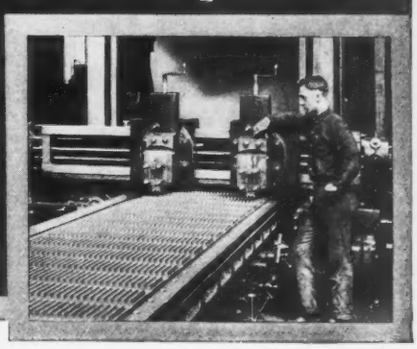
* * *

AN UNUSUAL CHIP

A section of a steel chip of unusual formation is shown in the accompanying illustration. The cause of this peculiar shape is not definitely known, but it is assumed that the changes in curvature are due to a variation in the hardness of the bar from which the chip was turned, one side being harder than the other. This chip was turned from a piece of heat-treated chrome-vanadium steel in the shop of J. E. Poorman, 1825 Bristol St., Philadelphia, Pa. The bar originally was about 1 1/2 inches in diameter, and the chip was from a second cut. Possibly, in heat-treating the steel, one side of the bar, due to uneven cooling, was left somewhat harder than the other side, thus causing a uniform variation in curvature throughout the length of the chip.

Letters on Practical Subjects





MILLING FIXTURE WITH SPECIAL LOCATING STOP

The irregular shaped hole *B*, in the part shown by the dot-and-dash lines in the accompanying illustration, is machined by broaching in a previous operation, and it is from this hole that the part must be located for milling the V-shaped slot at *A*. The outer end of the work must also be properly located.

On account of the small size of the hole *B* and the distance from the hole to the locating stop *D*, which bears on the rough surface of the part, it is necessary that the stop be of the sensitive adjustable type. It must be designed to permit the operator to secure it in place, when properly adjusted to support the work, without forcing the piece to exert pressure on the locating plug which fits the broached hole at *B*. If the stop *D* is allowed to exert much pressure on the work, it may throw the outer end of the work 1/16 inch or more out of alignment. By means of the adjustable stop, any play or looseness of the work on the locating plug can be eliminated.

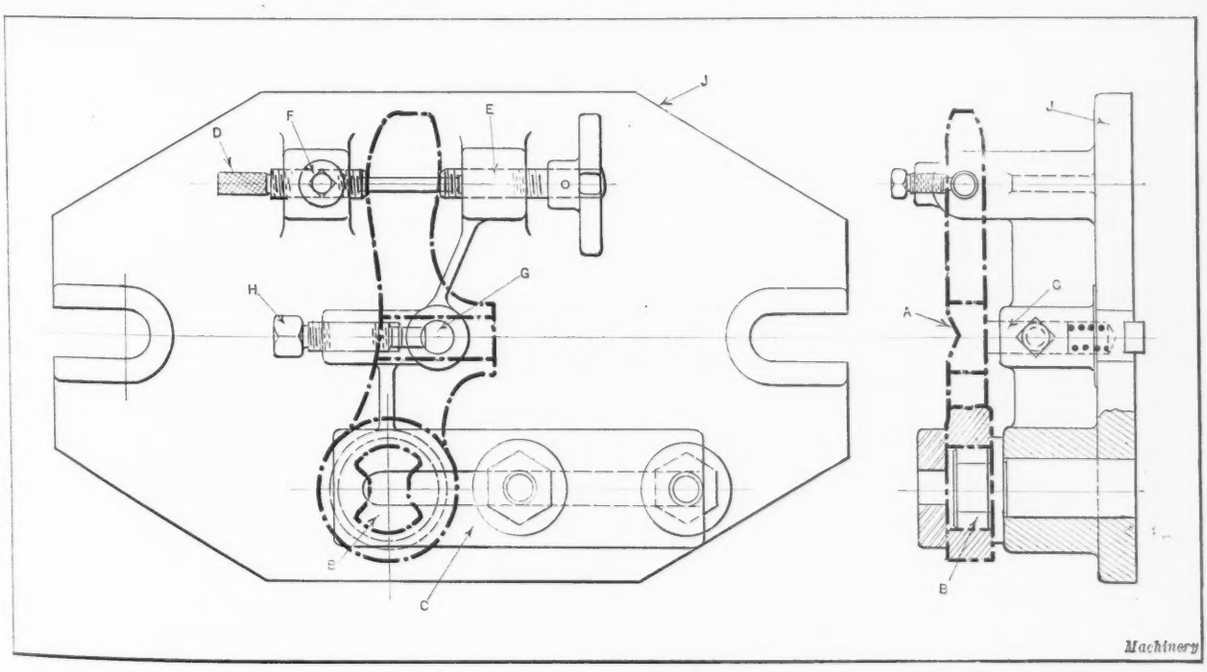
The work is held in place by a clamp *C*. The screw *D* is adjusted with the fingers until it is in contact with the work. The knurled portion of screw *D* is turned to a small diameter, in order to prevent the operator from exerting too much pressure on the work. After making this adjustment, screw *E* is tightened against the work so that it is held securely in place, following which clamp *C* is tightened down to hold the work in position. The check-screw *F* is also tightened to prevent screw *D* from becoming loose. The spring pin support *G* is then released and allowed to come in contact with the work, where it is clamped in place by tightening the screw *H*, after which the milling operation is performed with a V-cutter in the usual manner, with the base of the fixture *J* clamped to the milling machine table. H. M.

JIG FOR DRILLING HOLES AT AN ANGLE

In designing jigs for use in drilling holes that are neither parallel nor perpendicular to the locating surfaces, the making of the jig may be simplified by the use of a construction or locating hole. The work shown at *W* in Fig. 1 is a ring in which a hole is to be drilled in the periphery at an angle *a* with one of the faces.

The ring is located on a plug *P* in the customary manner. The locating hole *H*, in a vertical line with the drill bushing, is of great assistance in obtaining the proper location of the work and the bushing. In laying out the jig, the hole *H* is drawn at the intersection of the center lines of the drill bushing and plug *P*, and dimension *C* is scaled off. In order to find the dimension *X*, let

A = radius of ring *W*; and



Fixture used in milling V-slot in Small Part

B = distance from the center of the hole to be drilled to the locating face.

We then have,

$$C = A \tan a \text{ and } X = C - B$$

In Fig. 2 is shown a jig similar to that in Fig. 1 with the exception that the construction hole H cannot be drilled in line with the drill bushing. In such a case, the hole is drilled an arbitrary distance from the locating face K of the jig, and the horizontal dimension X is computed.

Using the same notation for A and B as in the previous calculations, we have,

$C = A \tan a$; $D = B - C$; $E = F + D$; and $X = E \cos a$

If the construction is such that point Y falls to the right of line MN, the computation is the same except for the value of D, which, instead of being $B - C$ is equal to $C - B$.

To make these computations clearer, we will take a concrete example.

Let A, B, and a in Fig. 1 equal, respectively, 2 1/2 inches, 3/8 inch, and 30 degrees. Then,

$$C = 2.5 \times \tan 30 \text{ degrees} = 2.5 \times 0.57735 = 1.44337$$

and

$$X = 1.44337 - 0.375 = 1.06837 \text{ or, say, } 1.0684 \text{ inch}$$

Now referring to Fig. 2, let A, B, F, and a equal 2 inches, 1 1/2 inches, 1/2 inch, and 30 degrees, respectively. Then we have,

$$C = 2 \times \tan 30 \text{ degrees} = 2 \times 0.57735 = 1.1547$$
$$D = 1.5 - 1.1547 = 0.3453$$
$$E = F + D = 0.5 + 0.3453 = 0.8453$$

and

$$X = E \cos a = 0.8453 \times 0.86603 = 0.7320 \text{ inch}$$

In the shop, the castings are machined to the proper angle on the faces J and K, Fig. 1, and the hole H is bored to the dimension G and X, Fig. 1, or G and F, Fig. 2. Next the hole for the plug P is bored perpendicular to face K and on the same center line as hole H. The final operation consists of locating the bushing plate L in the right position. In one direction, it is lined up with hole H, and in the other, with the locating plug P.

This method is not only a great time-saver, but it also allows a great deal of flexibility in taking care of mistakes in the tool-room. Should the holes for plug P be bored too low with reference to the construction hole H, all that it is necessary to do is to determine, by actual measurements, the amount, and deduct that from A, and then go over the calculation and find a new value for X, in the case of Fig. 2. In the case shown in Fig. 1, it might be necessary to find a dimension in the horizontal plane so that the drill bushing and hole H will no longer be in a straight line.

Of course, there is no harm in this procedure, as long as the hole in the work is where it belongs. The same is true with regard to dimension X in Fig. 1 or F in Fig. 2. If the toolmaker should err, all that has to be done is a little more figuring and a new figure established for locating plate L.

Cleveland, Ohio EDWARD HELLER

SAFETY DEVICE FOR PRESS

A safety device for a punch press which is radically different from any in common use has been installed in a large automobile manufacturing plant. A post with a number of sheaves or pulleys was erected at the back of the operator, and a light steel cable strung over the pulleys. One end of the steel cable was attached to a reciprocating device operated by the crankshaft of the press, while the other end of the wire was hooked to a strong leather band which the operator wore on his wrist. The reciprocating device on the crankshaft was so adjusted that it would draw in the cable the moment the press ram began to descend, and keep it drawn back until the ram began its upward movement.

In operating the press, the workman pulls down a lever with his right hand, and this movement engages the clutch, causing the crankshaft to revolve. Before the ram is half way down, however, the safety device draws the operator's left hand away from the die and out of the danger zone. It is evident that this device will work at all times, regardless of whether or not the catch on the clutch operates properly. If the press should repeat, the cable will draw the operator's hand away from the die before any injury can be done. With some modifications, this type of safety device could be made to operate on both hands and could also be arranged to pull or draw the hands to one side instead of directly back from the die.

E. D. H.

GRINDING CHANNELING CUTTERS

The channeling cutters used for milling channels in the sides of main and side rods are held for sharpening in the special grinding fixture to be described. Little trouble would be experienced in grinding these channeling cutters, were it not for the corner radius that requires some simple means of giving the cutter a circular movement. The fixture illustrated has proved very satisfactory for this purpose. The

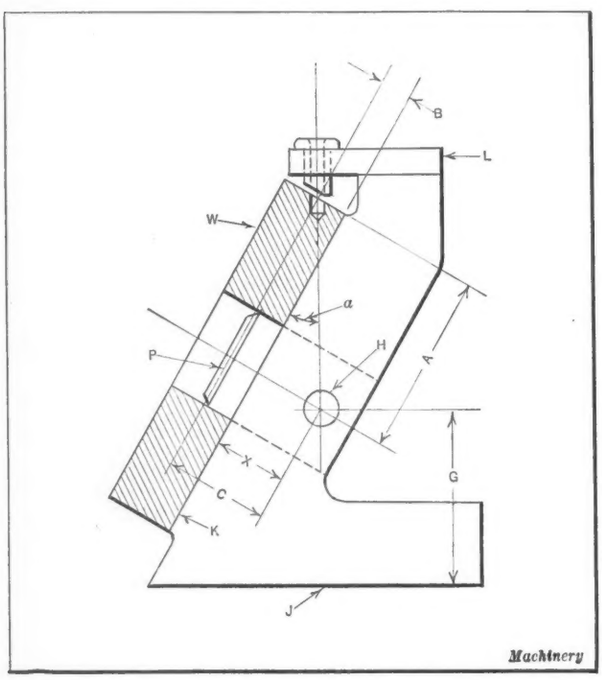


Fig. 1. Diagram used in explaining Method of locating Drill Bushing for drilling Holes at an Angle

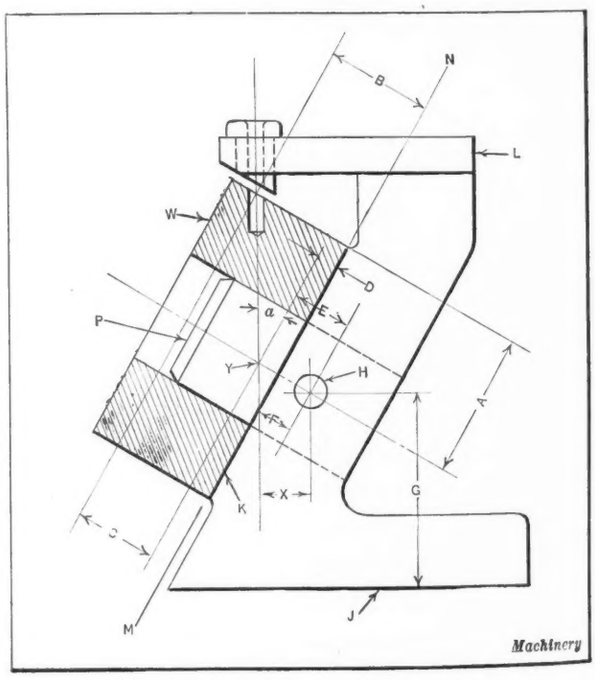
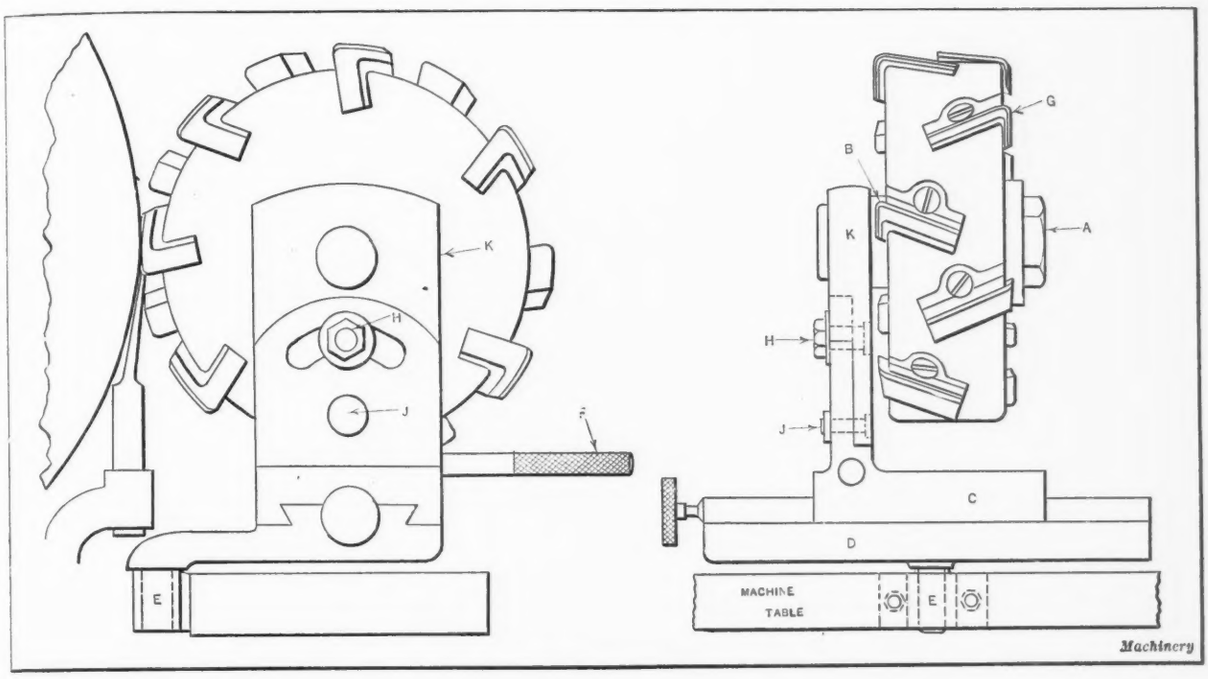


Fig. 2. Diagram used when Conditions are Different from those indicated in Fig. 1



Grinding Fixture for Cutters used in milling Channels in Sides of Connecting-rods

cutter to be ground is placed on stud *A*, which is provided with two ball races to enable the workman to turn the cutter easily as it moves along the tooth-rest. In grinding a corner, as at *B*, to the required radius, slide *C* is adjusted along base *D* until this corner is in vertical alignment with the axis of pivot *E*. Handle *F* is then used to swing the fixture about pivot *E* while grinding.

The straight part of the cutter is next partly ground by holding the swinging part of the fixture against a stop on the machine table, and then traversing the table. One corner and half of the face or straight section are ground before grinding the corner on the opposite end. The fixture is adjusted for grinding corners on side *G* by merely traversing slide *C* until side *G* is in alignment with the axis of pivot *E*. Then the operations previously described are repeated. As the cutter wears, it is necessary to make adjustment at *H* in order to maintain the same corner radius. This adjustment is made by loosening nut *H* and swinging part *K* of the fixture about pivot *J*. The sides of the cutters are ground by clamping the fixture in the proper position and traversing the table.

Cleveland, Ohio W. M. Hayes

TESTING FIT OF BUSHING WITH AN AIR GAGE

In spite of the rigid inspection of the outside diameter of the wrist-pin bushings pressed into the accurately broached holes in the connecting-rods of a gasoline engine, it was found necessary to subject all the assembled rods to a testing operation, in order to prevent any faulty rods from passing inspection. As the bushings were assembled by air pressure, it was a simple matter to attach an air gage to the assembling press in such a way as to show the pressure required to press each bushing into place. If the pressure was less than the minimum amount necessary to assemble a properly fitted bushing, it was obvious that the fit was not tight enough. The minimum pressure allowed to give the desired fit was calculated, and a mark made on the gage dial at a point indicating this pressure. If the needle of the air gage did not pass this point, the operator was required to throw out the rod assembly.

This procedure was only partially successful, owing to the fact that the operation of pressing the bushings into place was performed so rapidly that the operator could not observe the gage needle and handle the work at the same time. A gage was then developed which caused an electric light to flash when the gage indicated the required pressure. This light was located close to the work, where the operator could readily see the flash without taking his eyes from the work. The regular inspecting operation was continued until it was definitely proved that the assemblies which passed the flash test were all properly fitted, after which this additional testing operation was discontinued. After the flash gaging process had been adopted, it was discovered that several inexpensive air gages with electrical attachments suitable for work of this kind were obtainable on the market, and for this reason illustrations of the gage made for the job described are not shown here.

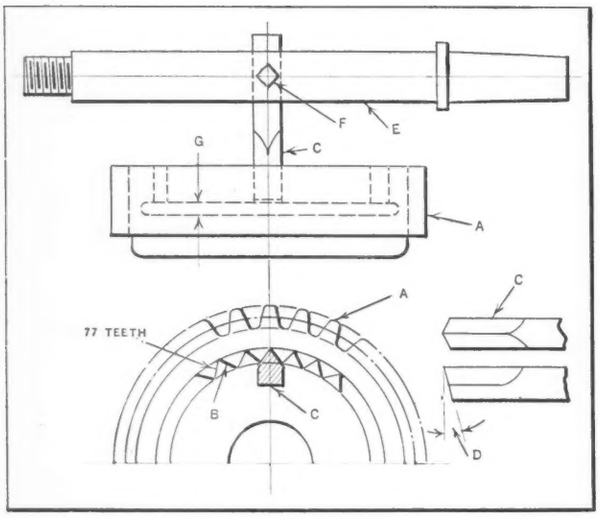
Detroit, Mich. F. Edgar

CUTTING INTERNAL GEAR TEETH ON A MILLING MACHINE

Very little difficulty is experienced in machining simple spur gears with the equipment available in most machine shops. Hence when a gear is urgently needed for repair purposes and cannot be readily obtained from the manufacturer or dealer, it is made up in the shop. The problem of replacing a broken internal gear, however, is not so readily solved. The teeth of an internal gear cannot be cut with the usual type of gear-tooth milling cutter or with the machine equipment available in many shops. For this reason, the method employed by the writer in cutting the teeth on an internal gear for a shaper should be of especial interest to those who handle machine shop repair work.

The gear, shown diagrammatically at *A* in the accompanying illustration, has spur teeth on the outside and 77 internal teeth at *B*. The internal teeth are of the 90-degree form, and at their ends have only a small clearance, as indicated by the dimension *G*.

The first step in cutting the 90-degree teeth was to grind a square tool bit to an angle of 90 degrees on the top face, as indicated by the cross-sectional view of the tool *C*. The end of the tool bit was also beveled slightly, as indicated by the angle *D*. This tool bit was fitted in a square hole in the arbor *E* where it was secured by a set-screw *F*. The arbor *E* was, in turn, placed in the spindle of a milling machine with the tool bit *C* held in a horizontal position. The arbor was then locked against rotation by bringing the back-gears into mesh.



Tool for cutting Internal Gear Teeth

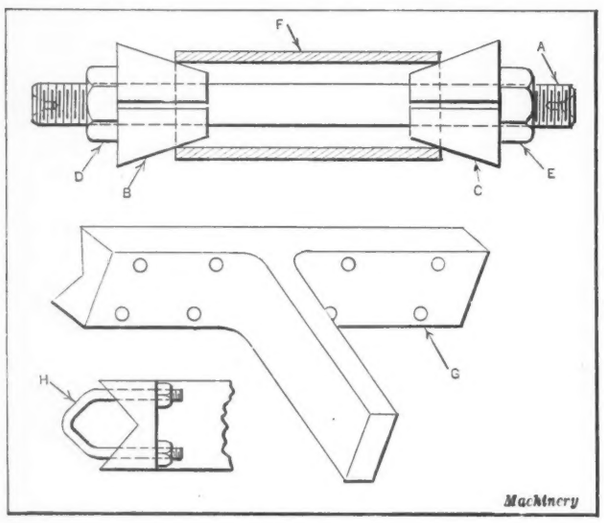
The gear blank was mounted on the dividing head, which was set to bring the center of tool *C* in line with the center of the dividing head spindle. A piece of scrap stock was next secured by a C-clamp to the back of the table to act as a stop and limit the travel of the table to a distance slightly greater than the length of the internal teeth. This prevented the end of the tool bit from striking the body of the gear at the back of the clearance space *G*.

By feeding the table back and forth with the handwheel attached to the feed-screw, and at the same time lowering the table after each feeding movement, the tool *C* was made to cut or shape the 90-degree teeth. The gear blank was indexed in the usual manner, after cutting a tooth space to the required depth. No trouble was experienced by the clogging up of chips, as the tool bit operated at the top of the gear, thus permitting the chips to fall away from the work. The time required to cut the 77 teeth to a depth of 0.100 inch was 2 1/2 hours. It may be of interest to mention that within 6 hours after the gear was broken the new gear was in place and the machine ready to operate.

Bronx, N. Y. DAVID H. SINGER

TURNING AND BORING BUSHINGS

In the upper view of the accompanying illustration is shown a cone mandrel for holding a bushing while turning the outside surface. This mandrel is made up of a bar *A*, two conical sleeves *B* and *C* which are a snug sliding fit on the bar, and two clamping nuts *D* and *E*. The conical sleeves are split on one side to permit them to contract and grip the bar *A* when forced into the ends of the work *F* by tightening the nuts *D* and *E*. Thus, the conical sleeves serve to center the work and at the same time obtain a firm grip on the bar *A*.



Devices for holding Bushings while turning and boring

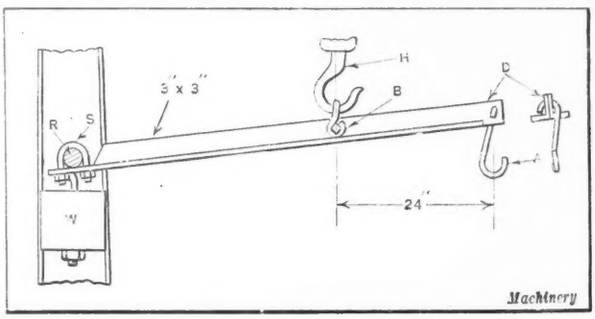
For internal boring operations on the bushings, a holder like the one shown in the lower view of the illustration is employed. This holder *G* has a V-groove in which the bushing is located and clamped in place by means of U-shaped clips like the one shown at *H*. When the holder is in use, the shank is held in the toolpost on the lathe carriage. The boring operation is performed with a boring-bar held between the lathe centers. The carriage feed is employed to feed the work over the rotating boring cutter in the boring-bar.

Washington, D. C. GEORGE A. LUERS

EXTENSION HOOK FOR PORTABLE CRANE

The accompanying illustration shows how a beam and a weight are employed on a portable floor crane to extend its reach beyond the wheel-base. The regular hoisting hook *H* of the crane is arranged to travel vertically on a line that would, if projected, fall within a line joining the centers of the four wheels on the base. In most cases, the base of the crane can be run under some span or overhanging member of the part to be hoisted in order to bring the hoisting chain directly over the work.

When it is desired to lift an object that is located ahead of the wheels on the crane base, difficulties are encountered as regards reach, direct upward pull, and the over-turning moment that is set up. These difficulties are eliminated,



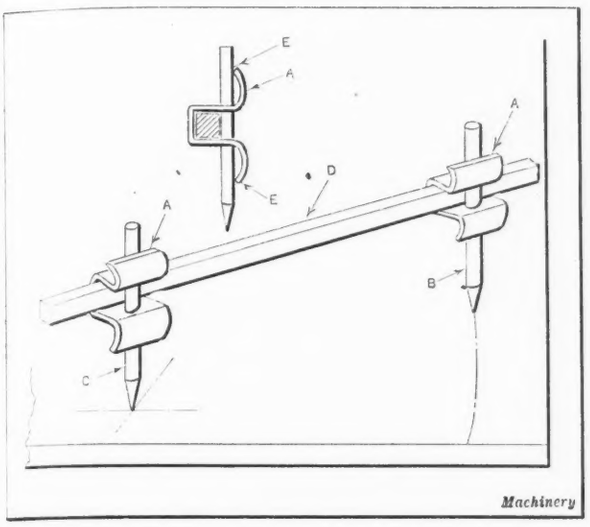
Extension Arm for Portable Crane

however, by using the extension hook described. This equipment was rigged up at the University of Michigan for use on the portable crane employed in the automotive laboratory for placing engines and other units on the test stands and for removing them after the tests are completed. Although the bases of the test stands are raised several inches above the floor level, it was found impossible to employ the regular crane effectively until it was equipped with the extension hook.

The two pieces of 3- by 3-inch angle-iron *D* are about 6 feet long, and have the webs cut away at the ends, as shown, to accommodate the hook *A* and the rod *R*. At the inner end, the webs pass under the rod *R* that serves to tie the two halves of the crane together. The U-shaped clips *S* permit the extension member to swing or pivot on the cross-rod *R*, and here the angles are spaced a foot apart. A weight *W* of about 200 pounds is swung from rod *R* to balance the load that overhangs the fulcrum point of the crane base.

The pieces *D* are brought together at their outer ends, and the auxiliary hook *A* passed through the vertical webs 24 inches from the point at which the regular hook *H* is attached. At the point *B*, in the "fall" line of the regular hook, a loop is provided which passes around a bolt extending through both pieces *D*. This loop extends upward and forms an eye for attaching the hook *H*.

Middletown, N. Y. DONALD A. HAMPSON



Beam Compass for Rough Lay-out Work

BEAM COMPASS FOR ROUGH LAY-OUT WORK

While there are various methods of constructing a tram or beam compass, the method used is generally determined by the requirements of the work. In the accompanying illustration, is shown a beam compass for inscribing arcs and circles of large radius on steel plates. The holders *A* for the scribing points *B* and center *C* are of unusual design, and because of their simplicity and desirable features should appeal to all mechanics.

The beam *D* is a length of square bar stock of a size to suit requirements. The holders *A* are made by bending pieces of flat sheet metal to the shape shown. The sheet metal used for the holders can be held in a vise and easily formed to the required shape by hammering. The holes in the holders are simply punched out to the required size. By referring to the illustration, it will be seen that the end extensions of the holders press against the point at *E*, and thus clamp the point securely to the bar. A beam compass constructed as shown will be found a useful addition to the tool equipments for machinists, tinsmiths, patternmakers, and draftsmen.

G. L.

MACHINING SPHERICAL BLOCK ON LATHE

Recently the writer was called upon to handle rather an unusual job which required the accurate machining of the spherical surfaces. The part was a compression head with upper and lower steel blocks *A* and *B*, Fig. 1. These blocks were to be hardened and ground, and were to have a brass cage between them which held 100 steel bearing balls, the idea being to have all the balls make good bearing contacts. The tolerance requirement of twenty-five hundred-thousandths inch made the job one requiring extreme accuracy. The dimensions on which this tolerance was specified were the 7-inch spherical radius of the block *A* and the 6 5/8-inch spherical radius of block *B*. The brass cage, however, was not required to be so accurate, it only being necessary to have it clear blocks *A* and *B*.

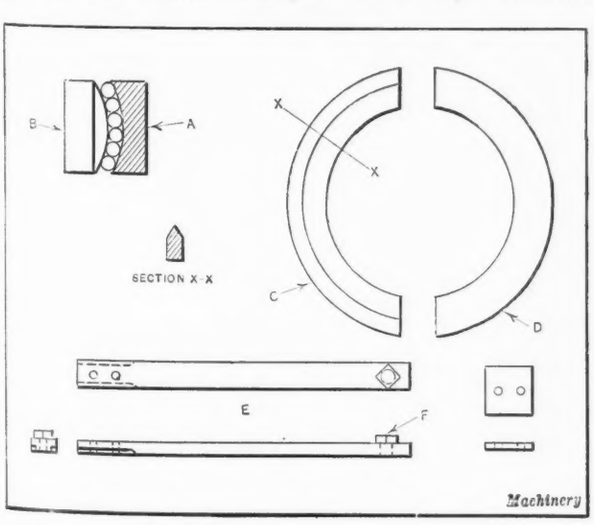


Fig. 1. Spherical Ball-bearing Block, and Equipment used in producing it

Not having any spherical turning or forming attachment, the writer equipped a lathe for the work, as shown diagrammatically in Fig. 2. First, the two pieces *C* and *D*, Fig. 1, were mounted on the lathe faceplate and bored and turned at one setting to the required dimensions. Piece *C* was made from 1/8-inch stock, and piece *D* from 1/4-inch stock. The piece *C* was chamfered off, as indicated in the cross-sectional view and was used as a gage. The piece *D* was made to serve as a cam, and was mounted on the lathe bed, as indicated in Fig. 2. The bar *E* was fastened to the tool-block, and a pin *F* on the end of bar *E*, coming in contact with cam *D*, caused the tool-block to follow the path of an arc when the cross-feed was engaged.

The first operation performed on the work *B* was that of turning the spherical surface with a regular turning tool held in the toolpost. In starting a cut, care was taken to have the point of the tool, the center of pin *F*, and the center of cam *D* in line with the center of the lathe spindle. The depth of cut was determined by placing a thickness gage between pin *F* and cam *D* when setting the tool. After the work was finish-turned, a toolpost grinder was rigged up, as shown in Fig. 2, for finishing the surface.

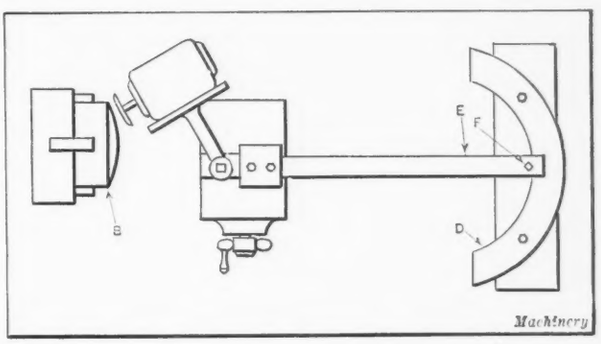


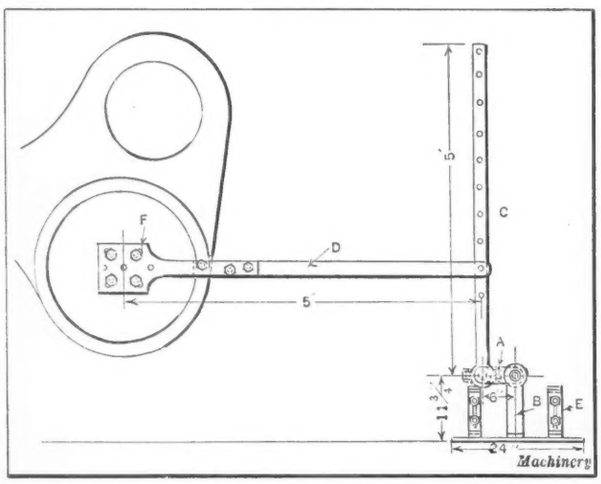
Fig. 2. Diagram of Set-up used to finish-grind Spherical Block

Gloucester, N. J. DAVID RODGERS

CYLINDER HEAD GRINDER

An inexpensive labor-saving device for grinding cylinder head joints is shown in the accompanying diagram, which represents an end view of the cylinder at the left, and a side view of the grinder at the right. The grinding device is operated by an ordinary air motor, which connects with a taper shank located on one end of crankshaft *A*. This crankshaft is supported by two bearings *B* located on each side of the crank. The crank is connected to the cylinder head through link *C* and arm *D*. As the crank revolves, an oscillating movement is imparted to the cylinder head which is held in position by an "old man" and a small planer jack, or any similar device having a screw adjustment. The air motor (not shown) is supported upon adjustable brackets *E*. Arm *D* is attached to the cylinder head by the studs of the stuffing-box for the piston-rod extension. The slots *F* in arm *D* are 2 inches long to provide for variations in positions of the studs. Link *C* has a series of holes, so that arm *D* can be attached in accordance with the height between the floor and the cylinder.

This grinder is revolved at about 50 revolutions per minute, and the floor-to-floor time for grinding a cylinder head and its mating joint in the cylinder proper is approximately one



Simple Design of Machine for grinding Cylinder Head Joints; Crank Mechanism at Right is driven by Air Motor not shown

hour. A 6-inch crank is used, the stroke of the crank being 12 inches. Rod *C* is provided with a brass bushing for the crank bearing. This device, which was designed by F. B. Harman, assistant superintendent of shops, has been in use since June, 1916, in the San Bernardino Shops of the Atchison, Topeka & Santa Fé Railroad and has paid for itself a great many times.

Atchison, Topeka & Santa Fé Shops, San Bernardino, Cal. J. R. PHELPS

CUTTING HELICAL GROOVES IN A LATHE

In the accompanying illustration is shown diagrammatically, a lathe set-up employed by a millwright for cutting the helical grooves in a planer feed-roll. The only lathe available for this job was not equipped with a lead-screw, but was provided with a power belt feed for traversing the carriage. The grooves in the feed-roll *Y* were required to be recut, as they had become so worn that the roll would no longer pull or draw the work through the wood planer.

The piece of cold-rolled steel *A* is fastened to the carriage by two bolts *B* and *C*, as indicated in the upper view. Two pins *D* serve to keep the piece *E* in place. The latter piece is set to the proper angle by the cut-and-try method, after which the pins *D* are set in their proper positions. The carriage is traversed by the power feed on the cutting stroke, but is run back by hand. The piece *L* is threaded to fit a tapped hole in the collar *W* at one end, and is provided with a weight *R* at the opposite end. The collar *W* is fastened to the roll *Y* by means of a set-screw *M*. As the carriage is fed back and forth, the inclined piece *E* imparts a rotary or oscillating motion to the roll *Y*. The weight *R* keeps the piece *L* in contact with the guide piece *E*.

After one groove is cut, the set-screw *M* is loosened and the roll turned around to bring the work into position for cutting the succeeding groove. As the spacing of the grooves was not required to be extremely accurate, their positions were located by means of dividers, center-punch marks being made at each division mark to facilitate locating the work for each cut. It was necessary, of course, to take a series of light cuts to complete one groove with this arrangement, no attempt being made to cut a groove to the required depth at one pass of the tool.

Philadelphia, Pa. CHARLES KUGLER

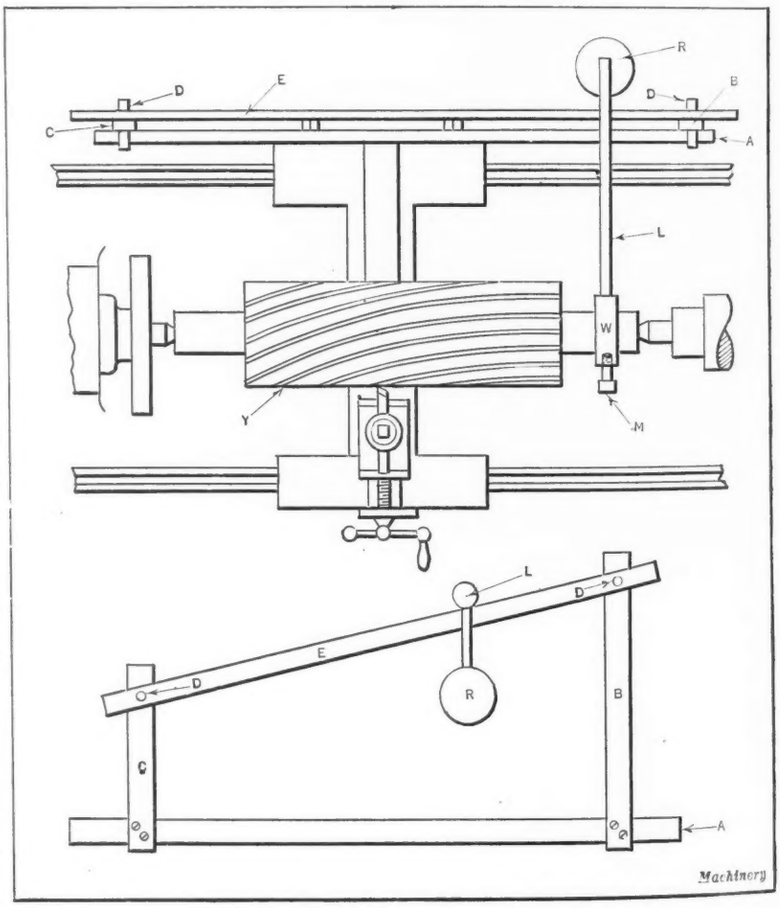
INTERNATIONAL STANDARDIZATION ORGANIZATION

The basis of a general international organization for industrial standardization was laid at the Third International Conference on Standardization, which recently completed its work in New York City, by unanimous agreement upon the draft of a constitution for the new international body. At this conference the national standardizing bodies in eighteen countries were officially represented.

The proposed constitution of the new organization, which is to be called the International Standards Association, states the aims and objects of the association as follows: "To lay the groundwork for international agreement upon standards by providing simple systematic means of interchanging information on the standardization work and activities in the different countries; to develop general guiding principles for the assistance of the national standardizing bodies; and to promote uniformity among the standards of the various national bodies." The work will also include the approval of international standards.

The members of the International Standards Association are to be the central national standardizing bodies existing in the different countries, one for each country, accepting the constitution. The conference recommended that the seat of the new organization be in London. Work on technical questions will be in the hands of "technical committees," with official representation from each country interested. The financial support is to be divided into three parts; 25 per cent of the total budget as a fixed sum to be divided equally among the national bodies; 50 per cent of the total budget based on the total annual foreign trade of each country; 25 per cent of the total budget based on the population.

The conference appointed a committee of seven to formally submit the proposed constitution to the twenty national standardizing bodies now in existence. The countries represented on this committee are Belgium, Czecho-Slovakia, Germany, Great Britain, Sweden, Switzerland, and the United States.

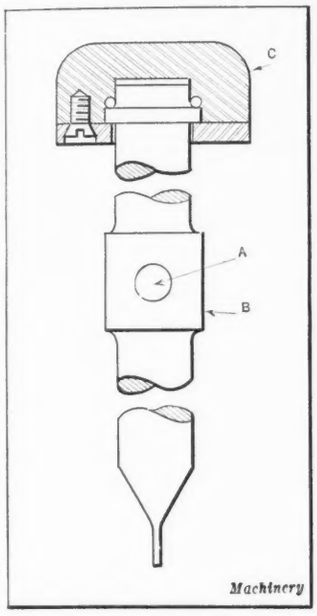


Lathe Set-up for cutting Helical Grooves

Shop and Drafting-room Kinks

HEAVY-DUTY SCREWDRIVER

The screwdriver shown in the accompanying illustration was designed by the writer for use in assembling and setting piercing dies, the various members of which were secured by heavy machine screws of the slotted-head type. The usual bent-bar screwdrivers and the straight type operated by wrenches were not satisfactory for this work, as they often slipped and injured the workman's hand. The heavy-duty screwdriver, however, has practically eliminated trouble of this kind.



Screwdriver for Heavy Work

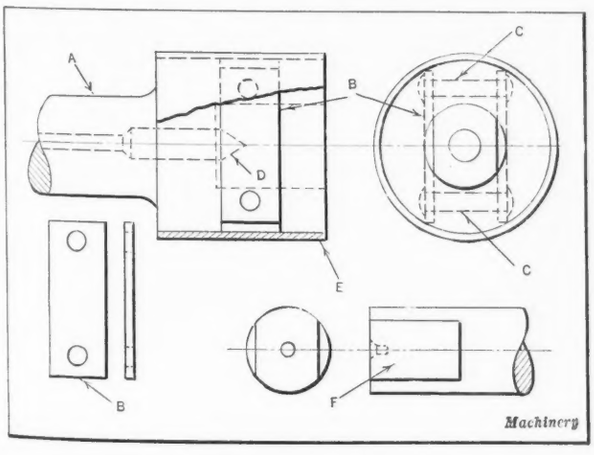
Referring to the illustration, the screwdriver can be turned by means either of a rod inserted in the hole *A* or a wrench applied to the square portion *B*. This screwdriver was made from a piece of 1-inch square steel turned to a diameter of 3/4 inch at each end, leaving a 1-inch square section near the middle in which the 13/32-inch hole *A* was drilled. The top of the screwdriver was fitted with a ball-bearing handle *C* as shown. The blade end of the screwdriver was beveled and oil-hardened.

Ypsilanti, Mich. FLOYD GRAVES

SAFE ARBOR-DRIVER FOR LATHE

For certain lathe work it is desirable to have an arbor-driving device that has no projecting parts to injure the operator. This is the case in finishing gun-metal hubs that are hand-tooled, smoothed with emery cloth, and polished in a speed lathe. The form of driver used for this work is shown in the upper view of the accompanying illustration.

The body *A* is turned down at one end to fit the tapered socket of the lathe spindle, and bored out at the front end to fit the work-arbor. A slot is cut across each side of the body, and two flat driving pieces *B* are secured to body *A* by the rivets *C*. The hole in the center of the body carries the hardened center *D*. The end of the work-holding arbor has a flat milled on each side, as shown at *F*. When the arbor is in use, the flat pieces *B* engage the flattened sides of the arbor, while the end is located and supported on center *D*. This provides a positive drive and an accurate method of locating and supporting the end of the arbor. The cylindrical part of the arbor is turned to fit the piece of tubing *E* which covers the slotted part of the body so that the holder presents a smooth surface which will not catch the clothing of the men or the polishing cloths.

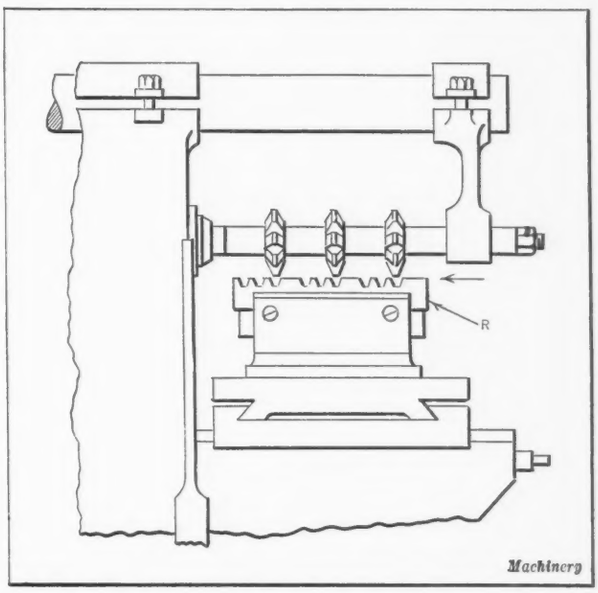


Driver for Lathe Arbor

Montreal, Canada H. MOORE

RACK-CUTTING KINK

The limited amount of table cross-feed travel available on most milling machines makes it impossbile to cut the teeth in long racks unless a universal or a rack-cutting attachment is employed. However, short racks may be cut by using two or more cutters mounted on the milling machine arbor in the manner indicated in the illustration.



Milling Machine Set-up for cutting Rack Teeth

The spacing collars between the cutters must be of the correct length, as determined by the number of tooth spaces between the cutters. For instance, a rack having twelve teeth of 1-inch pitch can be cut with a table movement of only 3 inches by using three cutters with spacing collars that locate the cutters exactly four tooth spaces apart.

Referring to the illustration, nine of the twelve tooth spaces required in rack *R* have already been cut, although the table has been indexed, in the direction indicated by the arrow, a total distance of only 2 inches. The next indexing movement of 1 inch in the direction indicated by the arrow will bring the work into the correct position for cutting the remaining three teeth in the rack. In some cases it is only necessary to use two cutters, while in other instances four cutters may be employed.

Philadelphia, Pa. CHARLES KUGLER

* * *

In 1925, metal-working machinery was exported to Japan to a value of $1,205,000, as compared with $1,981,000 in 1924. The total of all machinery was $6,254,000 in 1925, as compared with $10,626,000 in 1924.

Questions and Answers

ASSEMBLING BUSHINGS IN CRANKCASES

R. A.—I would like to obtain an opinion on the best method of assembling bushings in camshaft bearings in crankcases, both those made from cast iron and those made from aluminum. Is there any method in use whereby these bushings can be put in place in one operation instead of assembling them one at a time?

AIR CHUCK DESIGN

N. M.—Could some reader of MACHINERY supply information on designs of different types of air chucks and air clamping devices for quick clamping of work, so as to reduce the time for putting in and taking work out of fixtures?

The above question is submitted to MACHINERY'S readers.

ETCHING ACID FOR HIGH-SPEED STEEL

A. N.—What acid can be used for etching high-speed steel?

A.—We are informed that a mixture of two parts of acetic acid, eight parts of nitric acid, and five parts of hydrochloric acid produces a very satisfactory etching fluid both for carbon and high-speed steel. Beeswax is used as a resisting covering on the surface to be etched, a coating of which is rubbed thinly and smoothly over the part to be etched. The acid mixture will act in two or three minutes, leaving a black deposit in the etched lines.

HORSEPOWER OF NON-METALLIC GEARS

E. L.—I would like to have explained the methods used and the formulas employed in calculating the horsepower of non-metallic gears, especially gears made from the material known by the trade name "Micarta."

A.—According to information published by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., manufacturer of "Micarta" gears and pinions, the calculations of such gears should be based, as far as possible, on the tables and formulas given in the following. There are certain so-called "preferred pitches" given in Table 1 which may be modified to suit conditions.

For computing the horsepower that a gear will transmit under known conditions, the following formula may be used:

$$\text{H.P.} = \frac{0.000095 \times S \times F \times Y \times V}{P}$$

TABLE 1. PREFERRED PITCHES

Horsepower Rating	Diametral Pitch, P	Horsepower Rating	Diametral Pitch, P
0 to 1/4	12 or less	10 to 15	4
1/4 to 3/4	10	15 to 25	3
3/4 to 3	8	25 to 60	2 1/2
3 to 7 1/2	6	60 to 100	2
7 1/2 to 10	5	100 to 150	1 1/2

Machinery

TABLE 2. VALUE OF Y FOR 14½-DEGREE INVOLUTE TEETH

Number of Teeth	Y	Number of Teeth	Y	Number of Teeth	Y
12	0.067	20	0.090	43	0.110
13	0.070	21	0.092	50	0.112
14	0.072	23	0.094	60	0.114
15	0.075	25	0.097	75	0.116
16	0.077	27	0.100	100	0.118
17	0.080	30	0.102	150	0.120
18	0.083	34	0.104	300	0.122
19	0.087	38	0.107	Rack	0.124

Machinery

TABLE 3. VALUE OF UNIT STRESS FOR DIFFERENT SPEEDS

Speed of Teeth in Feet per Minute	Value S	Speed of Teeth in Feet per Minute	Value S	Speed of Teeth in Feet per Minute	Value S
100	5143	700	2769	1700	1565
150	4800	800	2571	1800	1500
200	4500	900	2400	1900	1440
250	4235	1000	2250	2000	1385
300	4000	1100	2118	2200	1286
350	3789	1200	2000	2300	1241
400	3600	1300	1895	2400	1200
450	3429	1400	1800	2600	1125
500	3273	1500	1714	2800	1059
600	3000	1600	1636	3000	1000

Machinery

in which

S = safe working stress of material, which varies with the speed as indicated in Table 3;

F = width of face of gear, in inches;

Y = a constant, depending on the number of teeth, as given in Table 2;

V = pitch line velocity in feet per minute (this velocity equals 0.262 × R.P.M. × pitch diameter, in inches); and

P = diametral pitch.

As an example, determine the horsepower rating of a pinion having 16 teeth, 4 diametral pitch, 3-inch face, and running at a speed of 1140 revolutions per minute. The pitch diameter in this case equals 16 ÷ 4 = 4.

$V = 0.262 \times 1140 \times 4 = 1195$ feet per minute;

$Y = 0.077$ for 16 teeth (from Table 2);

$S = 2006$ for a peripheral speed of 1195 feet per minute.

Table 3 shows $S = 2000$ for a peripheral speed of 1200 feet per minute, but the exact value of S is obtained from the formula:

$$S = \frac{600}{600 + V} \times 6000 = 2006$$

In the foregoing formula, the value 6000 is the safe working stress, in pounds, for static load. This is considered a correct value for "Micarta."

Then we have,

$$\text{H.P.} = \frac{0.000095 \times 2006 \times 3 \times 0.077 \times 1195}{4} = 13.15$$

AUGER SPEEDS

A. Z.—What are the correct speeds for different sizes of machine augers, and how should these speeds be modified for hard and soft woods?

A.—Unlike metal drilling, it is impossible to state the precise number of revolutions per minute for augers, owing to the factor of seasoning. For example, with the same wood, say pine, speeds could vary by as much as one-third for samples that were very resinous or not properly seasoned. A hard wood, say mahogany, can be satisfactorily cut at a heavier feed and quicker speed than a soft wood badly seasoned or spongy. With spongy woods, there is often difficulty in clearing the chip or core, and this limits the speed. Again, many wood-working machines, have an insufficient range of speeds, and small augers have to be underspeeded to avoid overspeeding the large ones. The following speeds for average woods may be taken as a guide for use with a good quality machine and auger: 1/2-inch augers 2000; 3/4-inch augers, 1600; 1-inch augers 1300; 1 1/4-inch augers, 1200; 1 1/2-inch, 1100; and 2-inch, 1000.

MILLING ELECTRIC-IRON SOLE PLATES

Three milling operations are performed on the sole plate of a certain make of electric iron to finish the curved and back edges. The appearance of the sole plate at the end of these operations may be seen at the right in Fig. 3; two rough castings are shown at the left in this illustration. All three operations are performed in a Milwaukee horizontal milling machine built by the Kearney & Trecker Corporation, Milwaukee, Wis. The use of special work-holding fixtures and a vertical double-spindle attachment enable high rates of production to be attained on this job.

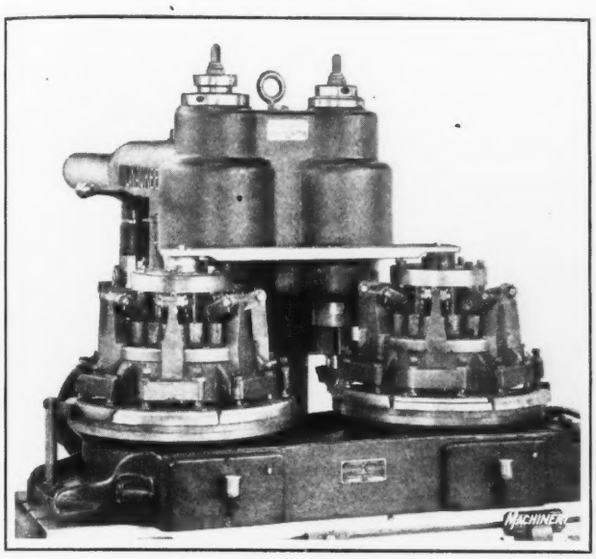


Fig. 1. Milling the Curved Edges of Sole Plates by Using Two Rotary Tables in Conjunction with a Vertical Double-spindle Attachment

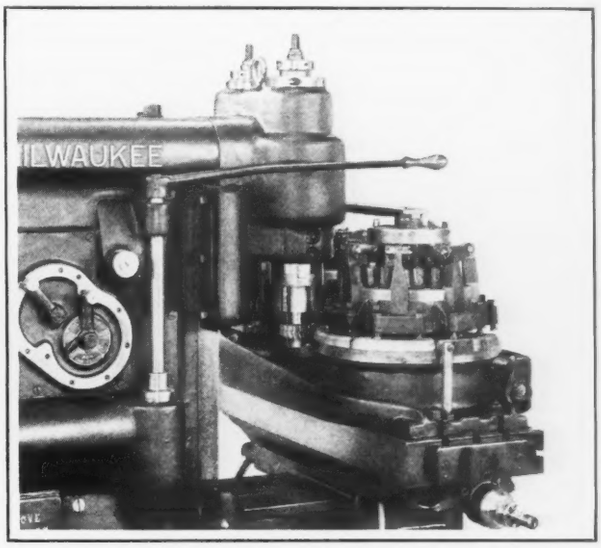


Fig. 2. Arrangement of the Vertical Spindles and their Cutters Relative to the Rotary Work-holding Tables

The double-spindle attachment is used in the first and second operations, which consist of milling the curved edges of the sole plate. Figs. 1 and 2 show the manner in which the machine is set up for these operations. Mounted on the regular table is a special fixture which has two rotary tables that carry the sole plates past cutters mounted on the two vertical spindles.

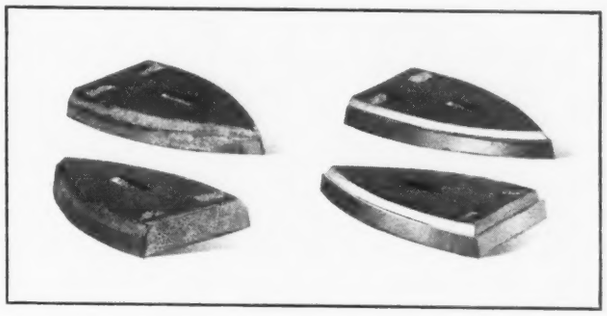


Fig. 3. Electric-iron Sole Plates before and after milling the Three Edges

The rough castings are loaded into the left-hand table, which travels clockwise, for milling one side of the sole plates. As each plate is brought around to the front of the fixture, it is removed and placed on the second table, with the opposite rough curved edge toward the outside of the table. This table rotates counter-clockwise, and the second curved edge is milled by means of cutters on the second vertical spindle. As the work is automatically clamped and unclamped, the operator simply has to reload the fixtures. Hence, with one operator attending the machine, both curved edges of from 200 to 240 sole plates can be milled per hour.

Each rotary table holds seven sole plates at one time. They are fastened in place by means of quadrant clamps, which are operated through a cam arrangement inside of each table. On the outside of the tables, just ahead of the point where the automatic clamping takes place, there is a spring wiper guard which forces each piece against its backing for the clamping.

When these operations have been completed on the desired quantity of sole plates, the machine equipment is replaced by that shown in Figs. 4 and 5, which is used for

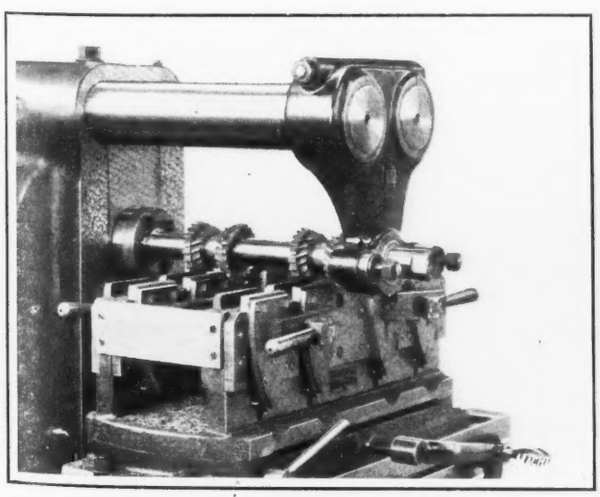


Fig. 4. Milling the Back Edge of Sole Plates with the Pieces held vertically in a Box Type of Indexing Fixture

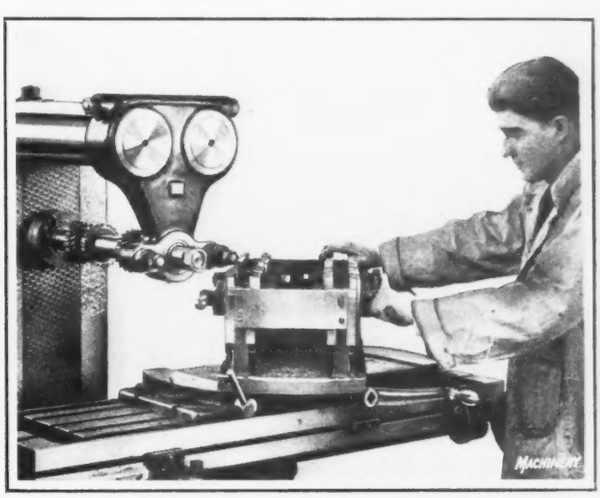


Fig. 5. Indexing the Work-holding Fixture at the End of a Cycle to bring Eight New Pieces in Line with the Cutters

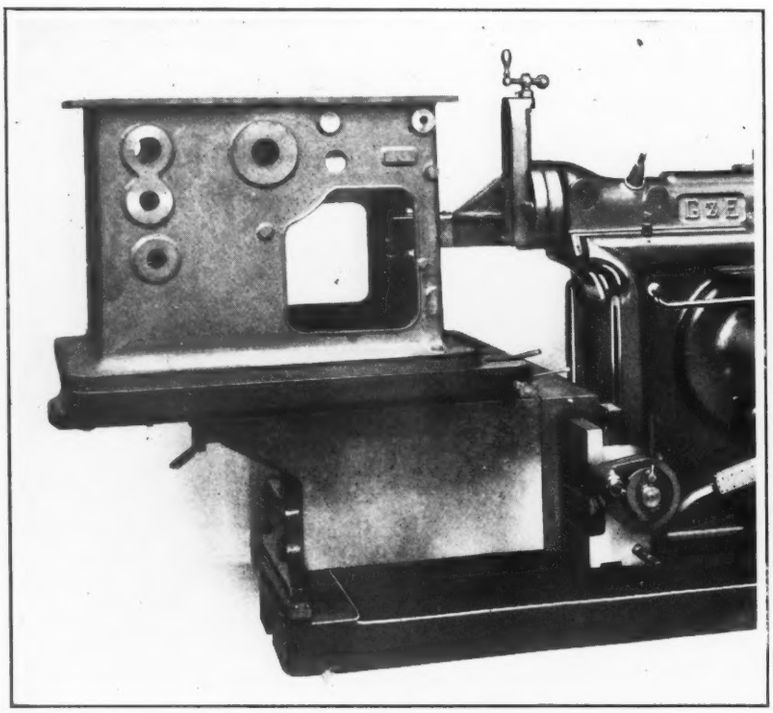


Fig. 1. Shaper equipped with Extension Tool-holder, Extension Base and Turntable Top for machining Interior Pads

milling the back edge of the work. In this case, the work-holding fixture is of the box type, and is indexed by hand on a base mounted on the machine table. Ball bearings facilitate the indexing. In this operation, eight plates are milled while the fixture is being reloaded with eight others, by the operator. The sole plates are located in the fixture from their finished curved edges. These edges rest in hardened and ground pockets, and near the point of each sole plate are two pins that gage the depth of the plates in the pockets.

In operation, the fixture is fed into the cut with the rapid traverse slowed down to mill the eight sole plates at one end, withdrawn from the cut with the rapid traverse, and indexed by hand, after which the cycle is repeated. The production in this operation averages 480 sole plates per hour.

* * *

MACHINING INTERIOR PADS ON A SHAPER

In designing a new Kelly printing press special attention was paid to keeping certain bearings and operating mechanism inside the base casting of the machine. Pads to be finished were so located as to be readily accessible, but machining the castings efficiently presented an interesting problem. As a temporary measure, a shaper was rigged up for finishing these pads on the first casting to be machined. Careful consideration of ways and means for doing the work on a production basis indicated that a shaper with special equipment would be an efficient machine for handling the work, and a Gould & Eberhardt 32-inch shaper with special equipment was installed for the purpose.

In building this machine, the base of a standard shaper was lengthened, and a longer table with a special roller-bearing support was provided (see Fig. 1). Mounted upon the table is a turntable faceplate of special design providing for 180 degrees of swivel, so that either end of the casting may readily be brought into the machining position. In place of the regular clapper-box, an extension tool-holder on the end of the ram is provided.

The casting measures 44 by 32 inches at the base, and is 28 3/4 inches high. Fig. 1 shows the casting on the shaper in position for machining one of the interior pads. When this operation is completed, the clamps securing the turntable on which the casting is mounted are loosened, and the turntable top is revolved one-half turn and clamped. A pad at the opposite end is now in position for machining. These two end pads each measure 2 5/8 by 4 inches.

For machining one of the side pads, as indicated in Fig. 2, the base casting is turned on its side, and is clamped upon parallels. This pad is 10 inches long and 6 1/2 inches wide. Above and slightly to the left of it there is a small pad measuring 3 1/2 inches by 2 5/8 inches; for machining this pad, the casting is turned over on the opposite side. Very close limits in keeping the pads square and parallel are maintained.

It is of particular interest to note the relatively small amount of special equipment needed to handle this job on a standard shaper. The faceplate and extension tool-holder used may be removed at any time and the standard clapper-box and vise substituted, thus making the standard shaper available for general use.

* * *

TON-MILE COST AS A MEASURE OF HUMAN PROGRESS

In the last analysis, the progress of every nation depends upon the ton-mile cost of transportation. From ancient times until the present moment the economic, political, and cultural progress of nations has depended largely upon reduction in the cost of transportation. When the cost of delivering merchandise is reduced, the wage scale increases, the standard of living is raised, education becomes possible, and the higher religious and cultural interests are developed. If it were possible to develop an aluminum alloy that would be lighter and cheaper than steel for equivalent strength, this would prove to be of the greatest importance in the development of automobile transportation.—*Edward S. Jordan*

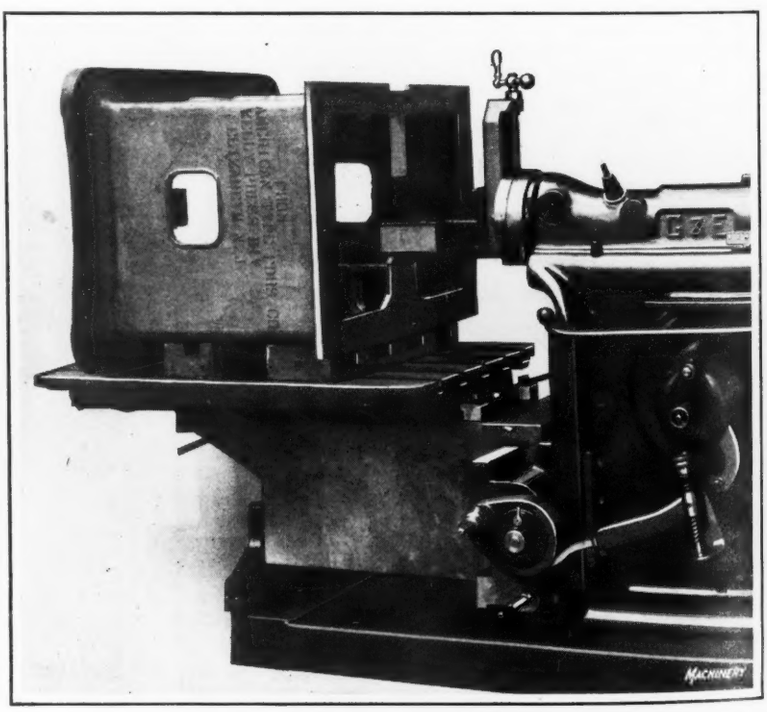


Fig. 2. Casting in Position for machining One of the Interior Side Pads

MACHINING CENTERS IN SHAFTS

By OTTO E. SEIFFERT

Trouble is sometimes experienced in turning shafts mounted between the centers of a lathe, through failure to machine the centers in the ends of the shaft properly. For example, the source of trouble in holding the diameter of a shaft to the tolerance required for sliding and running fits has, in several instances, been traced to unsuitable centers in the work. Difficulty in machining shafts to give press and force fits of a given assembling pressure has also been caused by the centers in the work wearing out of round during the turning and grinding operations. Trouble of this kind is generally experienced when the centers in the work are too small.

In addition to supporting the weight of the work, the centers must resist the cutting pressure of the tool. If the area of the bearing surfaces of the centers is too small, the pressure per square inch will be so great that the centers will be quickly worn out of round. In many cases, the centering machine operators have insufficient instructions regarding the depth of centers required in work of different sizes. Then, too, many operators do not realize that the accuracy of the work depends to a considerable extent on the area of the bearing surfaces of the centers. The only tables that could be found containing information on centering failed to take into consideration the length of the work, its weight, or the cutting pressure of the tools.

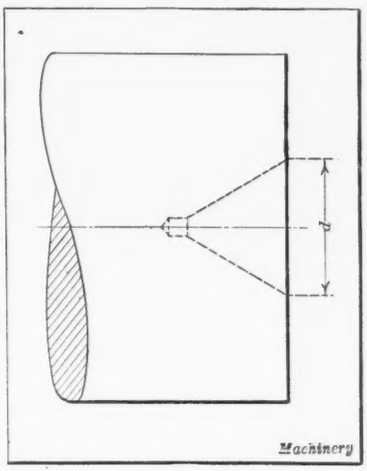


Fig. 1. End of Centered Shaft

It was found that the greatest deformation or wear on the centers took place during the first roughing cut, when the weight of the work was the greatest and the cutting pressure on the tools the least uniform. Experiments tend to show that the pressure per square inch on the center bearing surfaces often varies from 2000 to 5000 pounds during one revolution of the work when taking the first roughing cut. Under such conditions, the lubricating oil is forced out from between the bearing surfaces on the center where the pressure is the greatest, so that the soft steel center of the work is rapidly worn away at this point by the hardened steel center of the lathe.

The centers of shafts that are turned without back-rests are often worn out of round when they are not deep enough. A continuous cutting pressure of approximately 3500 pounds is delivered by a 10-horsepower motor, and a pressure of about 2000 pounds by a 5-horsepower motor. The weight of a shaft 12 inches in diameter and 12 feet long is about 4550 pounds, which gives a bearing pressure of 2275 pounds on the tailstock center. The cutting pressure, when taking the first roughing cut, is not uniform, being varied by hard spots in the material and, in many cases, by the eccentric position of the centers with respect to the outside or rough surface of the shaft. Practice has shown that the load on the center should not be greater than 3000 pounds per square inch, and the formula given in the following which was used in preparing the charts, Figs. 2 to 4, can be used to determine the dimension *d*, Fig. 1, of centers that will meet this requirement.

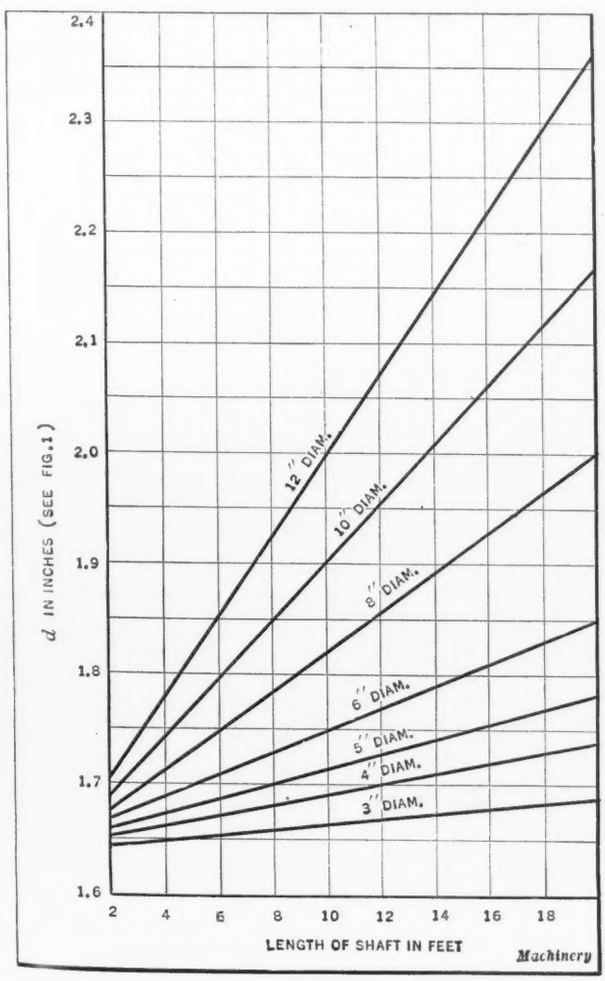


Fig. 2. Chart giving Size of Centers for Work turned on Lathe equipped with 10-horsepower Motor

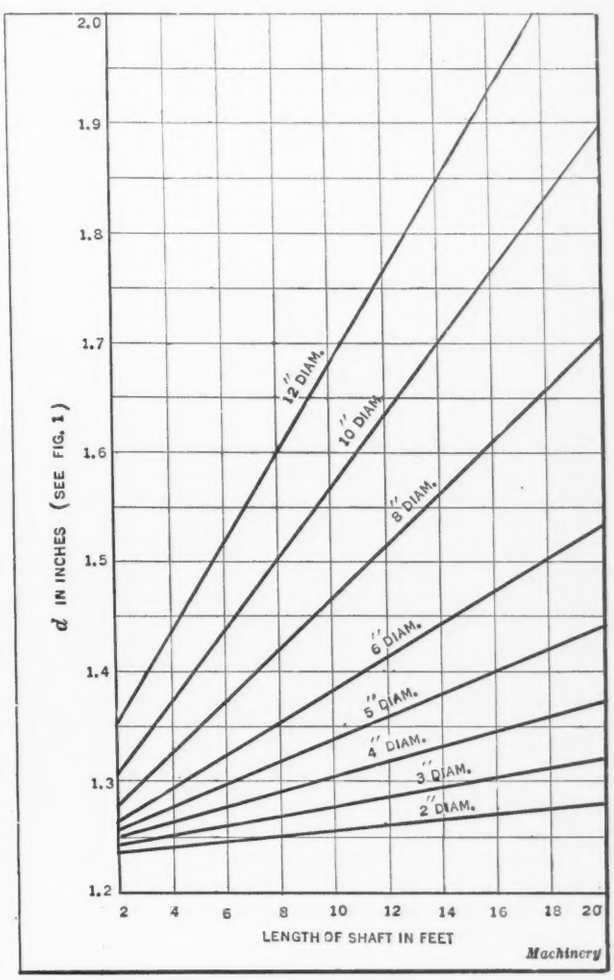


Fig. 3. Chart giving Size of Centers for Work turned on Lathe equipped with 5-horsepower Motor

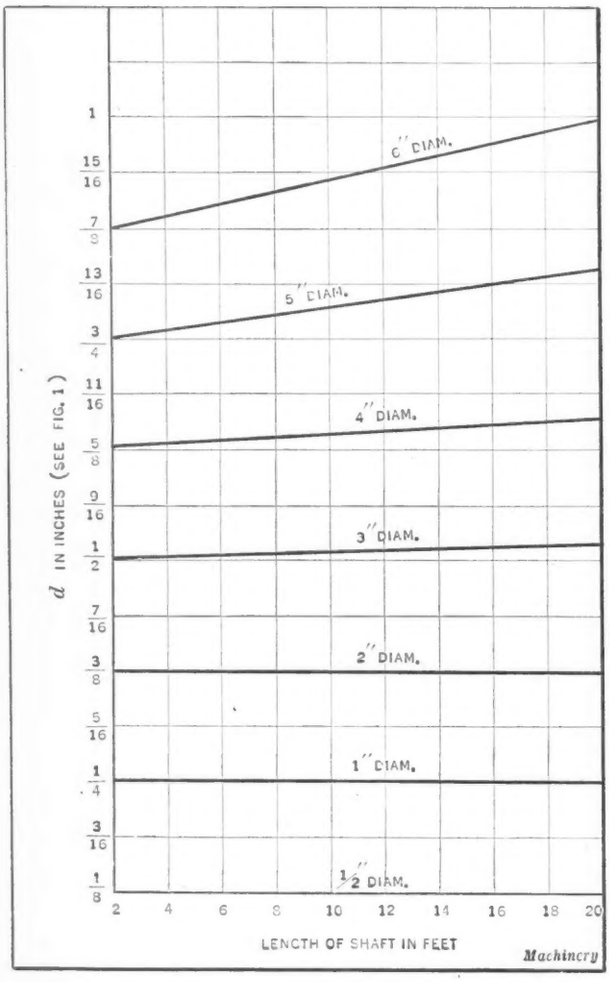


Fig. 4. Chart giving Size of Centers for Work of Small Diameter supported by Back-rest

$$d = \sqrt{\left(\frac{W}{2} + P\right) \times 0.008}$$

in which W = weight of shaft and P = cutting pressure.

The chart in Fig. 2 is for use in determining the diameter d of the center required in turning work on a lathe driven by a 10-horsepower motor. The chart in Fig. 3 is for use in finding diameter d when the work is to be turned on a lathe driven by a 5-horsepower motor.

The following example will serve to show the method of using the charts. Let us assume that a shaft 10 feet long and 12 inches in diameter is to be turned on a lathe driven by a 10-horsepower motor. Referring to Fig. 2, we find the line at the bottom of the chart designated "Length of Shaft in Feet." Now following the vertical line above the figure 10, we locate the point at which the vertical line intersects the diagonal line representing a shaft diameter of 12 inches. Following the horizontal line which passes through this point to the left, we find that the diameter d, as given in the column at the left-hand side of the chart, is 2 inches.

The chart in Fig. 4 serves as a guide in centering small work for which a back-rest is employed. The tendency in centering this class of work is to make the centers deeper than necessary, thus spoiling the appearance of the shaft. By using the values given, this fault will be avoided.

* * *

At the fifth annual convention of the National Industrial Advertisers' Association, held in Philadelphia June 19 to 24, the Bridgeport Brass Co. won the first prize for "the best use of art in industrial advertising," the prize being a Maxfield Parrish painting entitled "The Spirit of Transportation." This prize was offered by Ezra Clark of the Clark Tructractor Co., Buchanan, Mich.

ESTIMATING TIME FOR MACHINE WORK

By BERNARD J. WOLFE

The usual method of calculating production time is rather a long drawn out task, involving reference to numerous tables and the making of various calculations. The tables presented here, however, simplify this work and save considerable time in preparing estimates on job and production work. They are particularly useful when bids for contract work must be submitted on short notice. The writer has used these tables for several years and has found that they give quite accurate results. The machining time, as determined from the tables, is based on the use of feeds and speeds recommended by machine tool manufacturers. The tables give the actual cutting time and do not take into account the time required in setting up the machine and in loading and unloading the work.

Table 1 simply gives the surface speeds, in feet per minute, which are usually employed for the materials most commonly used in machine construction.

Table 3 gives the time required for the tool to travel 1 inch when performing turning operations. In the left-hand column is given the speeds, in surface feet per minute. The columns to the right give the approximate diameters of the stock to be machined. Having given the surface speed in feet per minute and the diameter of the work to be turned, we can determine at a glance the time required for the tool to travel 1 inch. For instance, if the surface speed in feet per minute is 150 and the diameter to be turned, 5 3/4 inches, we locate 150 in the left-hand column and then follow the line to the right until we locate the diameter to be turned, or 5 3/4 inches. Now if we follow this column directly up to the line at the top of the table, we find that 0.72 minute is required for the tool to travel a distance of 1 inch. Thus if the surface to be turned was 4 inches long, the time required for the complete cut would be $4 \times 0.72 = 2.88$ minutes.

Table 2 is intended for use in estimating the time required in drilling holes. In using this table, we first locate the diameter of the drill in the column at the left-hand side of the table and follow this line along to the right until we come to the column headed Cast Iron, or whatever material is to be drilled. In this column, we find the time, in minutes, required to drill a depth of 1 inch, employing the speeds and feeds ordinarily used. The time required for drilling the full depth is obtained by multiplying this value by the total depth of the hole.

TABLE 1. AVERAGE CUTTING SPEEDS

Material	Surface Feet per Minute
Cast iron, rough; steel casting; hard machine steel; alloy steel	50 to 60
Cast iron, finish; tool steel	60 to 80
Malleable iron; soft machine steel	80 to 100
Bronze	100 to 150
Brass; copper	150 to 250
Aluminum	250 to 400

Machinery

TABLE 2. TIME REQUIRED FOR DRILLING

Diameter of Drill, Inches	Brass Bronze	Cast Steel Malleable Iron	Cast Iron	Drop-Forging Tool Steel	Cold-rolled Steel
	Minutes Required to Drill a Depth of One Inch				
1/16	0.24	0.20	0.42	0.27	0.27
1/8	0.16	0.30	0.60	0.42	0.20
1/4	0.11	0.42	0.78	0.55	0.27
1/2	0.18	0.67	1.32	0.87	0.43
3/4	0.22	0.82	1.64	1.10	0.54
1	0.25	0.92	1.88	1.25	0.63
1 1/2	0.33	1.22	2.45	1.64	0.82
2	0.44	1.62	3.25	2.18	1.10

Note: The time given is based on using a drill jig or fixture on which the hole locations are marked, and includes the time for moving from hole to hole.

In Table 4 is given the average grinding time required for cylindrical grinding, and is applicable to both rough- and finish-grinding. Generally, more stock must be removed when rough-grinding than when finish-grinding. Consequently, the rough-grinding operations will take, on the average, about as much time as the finish-grinding operations, and the table may, therefore, be used with fair accuracy for either type of grinding.

TABLE 3. CUTTING TIME FOR VARIOUS DIAMETERS

Surface Feet per Minute	Minutes Required to Travel One Inch								
	0.17	0.24	0.35	0.48	0.72	1.0	1.4	2.0	2.9
	Approximate Diameters of Stock								
50	7/16	5/8	15/16	1 1/4	1 7/8	2 3/4	3 7/8	5 1/4	7 5/8
60	9/16	3/4	1 1/8	1 1/2	2 1/4	3 1/4	4 1/2	6 1/4	9
80	3/4	1	1 1/2	2	3	4 1/4	6	8 1/2	12
100	15/16	1 1/4	1 7/8	2 1/2	3 7/8	5 1/2	7 5/8	10 5/8	
125	1 1/8	1 5/8	2 1/4	3 1/4	4 3/4	6 3/4	9 1/2		
150	1 3/8	2	2 3/4	3 7/8	5 3/4	8	11 1/2		
175	1 5/8	2 1/4	3 1/4	4 1/2	6 5/8	9 1/2			
200	1 3/4	2 1/2	3 5/8	5	7 5/8	10 3/4			
225	2	2 7/8	4 1/8	5 3/4	8 1/2	12 1/4			
250	2 1/4	3 1/4	4 1/2	6 3/8	9 1/2				
275	2 1/2	3 1/2	5	7	10 1/2				
300	2 3/4	3 7/8	5 1/2	7 3/4	11 1/2				
350	3 1/4	4 1/2	6 1/2	9					
400	3 5/8	5 1/8	7 1/4	10 1/4					

The cutting time given in this table is based on a feed of 1/72 inch per revolution of the work.

WROUGHT IRON MADE BY MECHANICAL PUDDLING

Wrought iron has been an important material for many centuries. The dearth of reliable published information on the properties of wrought iron from the viewpoint of modern metallurgy is surprising. An investigation recently completed by H. S. Rawdon and Samuel Epstein of the Bureau of Standards, Department of Commerce, had for its purpose the study of the effect of phosphorus, one of the ever-present impurities in wrought iron, upon the properties of the finished iron as made by different puddling processes. Recently, mechanical puddling processes have been advocated and used to a considerable extent in the manufacture of wrought iron to replace the time-honored hand puddling method, on account of the high labor costs the use of the latter necessarily entails. Very little has as yet been published on the properties of the wrought iron made by these newer processes.

Phosphorus in wrought iron is usually regarded with some concern since it embrittles the iron, that is, makes it "cold short." The phosphorus is contained in both the iron matrix and the slag threads to which the wrought iron owes its characteristic "fiber." Only the phosphorus in the iron matrix, however, affects the properties of the metal. Mechanical puddling appears to be more effective in reducing the phosphorus content to a lower figure than hand puddling. Experiments were carried out on wrought iron made by each of the two methods on a "split" heat of pig iron, the two parts of the heat being refined by the two processes, hand and mechanical puddling, respectively. For certain purposes, such as drill pipe for which a "stiff" material is needed, a certain percentage of phosphorus in the iron is desirable. The amount, in such a case, is usually considerably higher than that in good quality bar iron for which the total phosphorus ought not to exceed 0.15 per cent.

The investigation was not extensive enough to warrant any sweeping conclusion concerning all the merits of wrought iron made by the two processes. However, nothing was noted which would show that wrought iron made by hand puddling cannot be equalled by mechanical puddling if properly carried out.

* * *

PROPOSED STUDY OF FOUNDRY COSTS

At a recent meeting of the American Foundrymen's Association's committee on foundry costs, a study was made of existing data of foundries having cost systems. The study led to the conclusion that relatively few foundries really know their actual castings costs and that the future work of the committee should be along the lines of educating foundrymen to the needs of using adequate systems and of showing the advantages to the foundry industry of using uniform cost methods. The committee plans to carry out its program by issuing reports and conducting discussion sessions at the annual meetings of the association.

The program planned for the 1926 Detroit convention will include a discussion of the economic necessity of adequate cost information; an explanation of how foundry costs can be determined without excessive clerical detail; and a presentation of an outline basis for practical classification of foundry costs. In addition, the committee is planning to conduct a contest on weight and production estimates of castings from non-ferrous steel, malleable, and gray iron foundries. Pattern equipment for castings from each branch of the industry will be on display, and those in attendance at the convention will be given a chance to submit estimates of the weight of the castings and estimates of daily production by the use of the equipment. Prizes are to be given to those submitting the best estimates.

TABLE 4. TIME REQUIRED FOR CYLINDRICAL GRINDING

Diam. of Stock, Inches	Length, in Inches, to be Turned													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Minutes Required to Grind													
1/4–1	2	3.0	4.0	5.0	6.0	....	....	....	....	....	....	....	....	....
1–2	3	4.0	5.0	6.0	7.0	8.0	9.0	10.0	....	....	....	....	....	....
2–3	4	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	....	....	....
3–4	5	6.3	7.5	8.8	10.0	11.3	12.5	13.8	15.0	16.3	17.5	18.8	20.0	21.3
4–5	6	7.3	8.5	9.8	11.0	12.3	13.5	14.8	16.0	17.3	18.5	19.8	21.0	22.3
5–6	7	8.5	10.0	11.5	12.0	13.5	14.0	15.5	17.0	18.5	20.0	21.5	23.0	24.5

The traverse speed of the work for roughing steel should be about two-thirds the width of the grinding wheel per revolution of the work, and for cast iron it should be slightly less. For finishing, a very narrow traverse per revolution is required. Broadly speaking, for removing stock, use a slow work speed and a fast traverse, and for finishing, a fast work speed and a slow traverse. When finishing cast iron, pass the work over the wheel as few times as possible; this will make the wheel less likely to glaze.

Machinery

SELF-CONTAINED TAPER-TURNING TOOL

By ALBERT A. DOWD

The most approved method of machining the taper on chrome-nickel steel bevel pinion blanks is by means of a single-point taper-generating tool. Material of this kind is very tough and wiry, and it cannot be successfully machined with a forming tool. The pinion shown in Fig. 1 is cut integral with the shaft, and has a 5/8-inch hole through the center. In this example, we are not particularly concerned with the tools used for centering, drilling, and countersinking the long hole and turning and threading the shank, as these operations are performed previous to the turret lathe operation that finishes the tapered portion of the pinion.

In Fig. 2 is shown the self-contained taper-generating tool employed for machining the tapered surface. The hole *A*, Fig. 1, is first bored and reamed, and the faces *B* and *C* are machined in one setting prior to the taper-turning operation, which is also performed without changing the setting of the work. The soft jaws *A*, Fig. 2, of the three-jaw geared scroll chuck are bored out to take the shank *D* of the pinion, the remainder of which passes back through the chuck into the spindle of the machine.

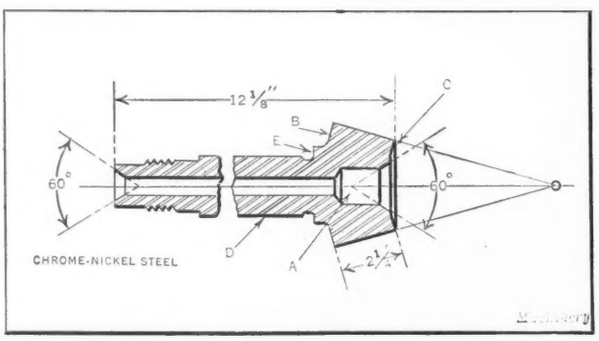


Fig. 1. Pinion made from a Chrome-nickel Steel Forging

End location of the work is determined by the shoulder *E*, which is brought against the projecting ends of the jaws. This method of holding the work prevents it from being loosened or distorted under the cutting action of the tools. As the piece is a chrome-nickel steel forging, it is necessary to remove a considerable amount of stock. A continuous and copious flow of lubricant must therefore be directed on the face of the tool.

The body of the taper-turning tool is of cast iron, and is bolted in the usual manner to the face of the turret. It is well ribbed to give rigidity, and is cut out at the front end to receive the vertical slide *F*, which carries the tool-holder. Two straps *G* hold the slide in place, and are fitted to allow a free sliding movement. A suitable gib for taking up wear is also provided. The tool *H* is firmly secured in a steel block *I*, which may be adjusted to two positions, according to the diameter of the work to be turned. The back of the tool body is planed to an accurate sliding fit on the rectangular bar *J*, a detail of which is shown in the upper right-hand corner of the illustration.

The slot *K* in bar *J* has the same angle as the surface to be turned on the work. When work of a different taper is to be machined, another bar *J* with a slot of the required taper must be employed. As the back of the tool body is cut out to receive bar *J*, the construction is naturally weakened, and in order to give it sufficient strength, the entire back of the tool is reinforced by a large plate secured in place by seven bolts, one of which is shown by the dotted lines at *L*. This plate forms a bridge which gives the required strength and at the same time makes it an easy matter to machine the body casting. At the back of slide *F*, a hardened block *M* is mounted on a pivot, which allows it to swing freely. This block engages the angular slot *K* in the taper bar *J*.

The screw *N* is carried in an overhanging lug at the top of the slide, and is used to compress the spring *O*, which serves to keep the block in contact with the upper angular surface of slot *K*. In the hub *P* there is a long sliding bar *Q*, which is splined, as indicated, to prevent rotation. A detail view of this bar is shown at *R*. At the forward end is a hardened revolving bushing *S* which enters the end of the work and revolves with it. The bar is cut out at *T* for clearance, and at *U* there is a slot which engages the hardened pin *V* in the operating lever *W*. Lever *W* is pivoted exactly half way between the pins *V* and *X*. Pin *X* engages the slot *Y* in the taper bar *J*.

A coil spring surrounds the smaller portion of the bar *Q*. The thrust of this spring is taken by the nut screwed into the outer end of the sleeve *Z*. This sleeve is threaded at the opposite end, and is screwed into the body of the fixture through the turret hole. In operating the device, the workman brings the turret forward until bushing *S* enters the work. Then when the feed is started and the turret moved

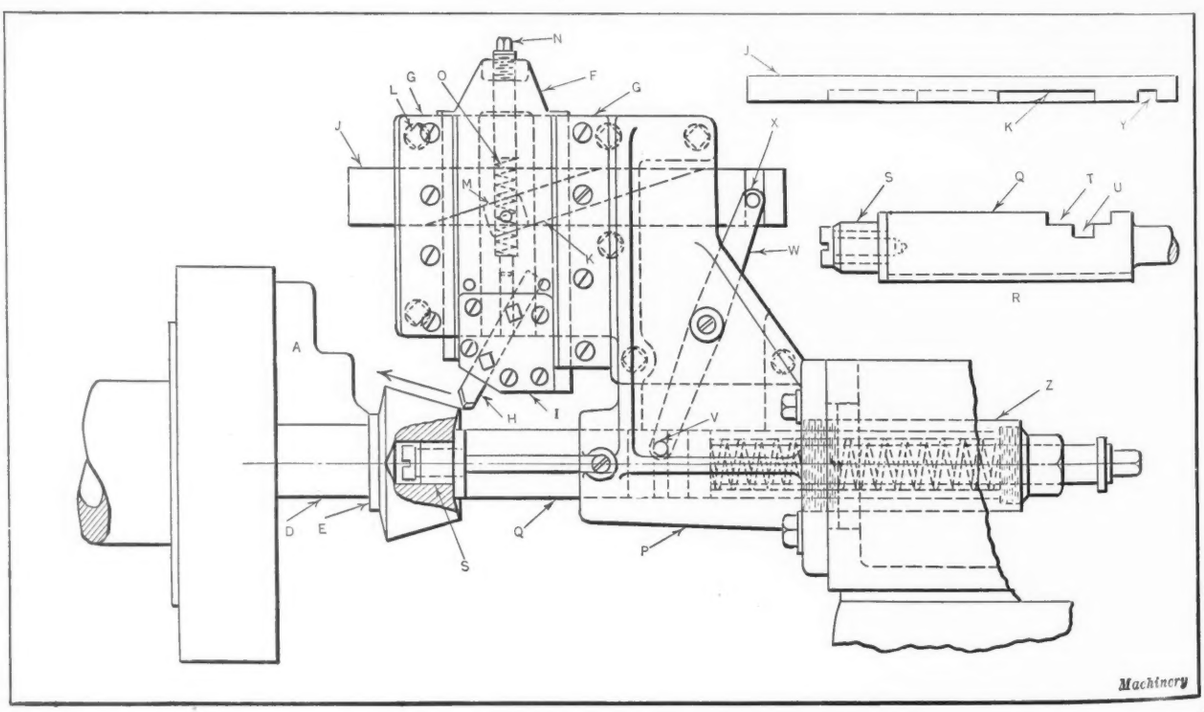


Fig. 2. Taper-turning Tool employed on Turret Lathe

forward, the entire tool movement is controlled by the taper bar. Lever *W*, engaging bar *J*, moves the latter member forward at exactly the same rate that the turret slide advances so that block *M* is forced to travel in slot *K* in the taper bar, thus producing the correct angle on the work.

To prevent bar *Q* from moving forward too far when the turret is withdrawn, a collar is placed on the outer end as shown. Lever *W* lies in a cored pocket at the back of the body of the tool, and is covered by a reinforcing plate when the tool is completely assembled. This cored pocket or opening runs down and meets the hole in which bar *Q* operates.

* * *

WIND PRESSURES ON BUILDINGS AND CHIMNEYS

It has always been recognized that in the design of engineering structures such as tall buildings, bridges, chimneys, transmission lines, radio masts, etc., it is necessary to make provision for the stresses produced by the pressure of high winds. However, the values of the forces produced by the wind, used by engineers in structural design, are based on experiments made many years ago by methods that are now known to be subject to large errors, and on models that do not resemble actual structures.

The Bureau of Standards has determined the actual pressure corresponding to a given wind velocity, but there still remains the problem of determining what wind velocity to use in designing a structure. Obviously, a higher velocity ought to be assumed in designing a building facing the lake front in Chicago than for a building in the downtown section of Washington.

The average wind pressure on a tall building when the wind is blowing at 76 miles per hour (100 miles per hour, as shown by a Weather Bureau, Robinson type anemometer) is about 22 pounds per square foot, according to results obtained by the Bureau of Standards. The value which is commonly used is 30 pounds per square foot. This would correspond to a true wind speed of about 88.5 miles per hour (118 miles per hour indicated speed). Gusts of this speed have only been observed in a few cities, such as New York, and St. Paul. The difference between the estimated true speed and the speed indicated by the anemometer is due to errors in the anemometer readings at high wind velocities.

These results were obtained by measuring the force of the wind on a model of a tall building mounted in the large outdoor wind tunnel of the Bureau. This tunnel is 10 feet in diameter, and in these experiments winds up to 70 miles per hour were produced, values for higher speeds being obtained by extrapolation. By means of small openings in the face and top of the model which were connected to a pressure gage, the pressures produced by the wind at various parts of the structure were measured. These measurements were made at seventy places on the face of the model and at forty-nine places on the top, with the wind coming from thirteen directions, varying from directly against one face to directly against the opposite face. Of course, in this work the wind always comes from one direction, and the model is turned on its mounting. The pressures obtained were then multiplied by the appropriate areas to give the total force on the model under the different conditions. The forces tending to overturn and to twist the model were also computed.

* * *

Statistics published by the Committee of Public Relations of the Eastern Railroads indicate that the gross receipts of 157 days in the year are needed for the payment of wages; of 27 days for locomotive fuel; of 70 days, for materials and supplies; of 24 days, for all other operating expenses; of 21 days, for taxes; and of 41 days, for interest on bonded and other debts and for the payment of rent. The gross revenues for 19 days out of the year are used for dividends, and the receipts of 6 days, for improvements.

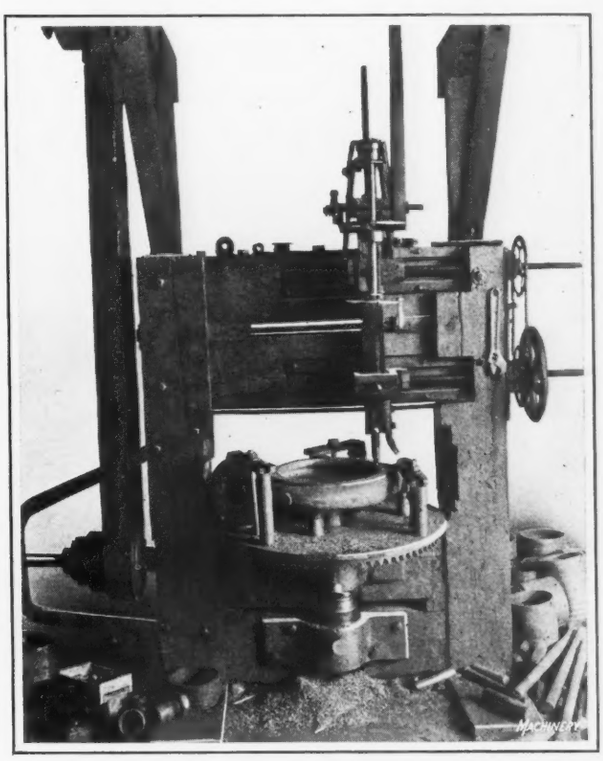
BORING MILL OF THE YANKEE TYPE

By J. L. LUCAS, J. L. Lucas & Son, Inc., Bridgeport, Conn.

Driving over the wonderful scenic "Ridge Route" from Los Angeles to San Francisco, we came into the little city of Fresno and stopped at the door of an open machine shop to ask the way. The proprietor was in the far end of the shop. He gave us the desired information with a smile, and we turned to come out. Near the door there was a machine, the like of which we never saw before. "Is that a boring mill?" we asked. "Yes," said the proprietor, and then he gave us the details.

About seven years before he was badly in want of a mill, and did not have the ready cash to buy it. He hunted through the junk yards, found a large bevel gear and pinion, made patterns for the table, and built the body of the mill, the uprights and cross-heads being of oak, put in a 5-inch square bar of steel for the sliding head, and rigged up a power feed for it with a hand cross-feed (see illustration).

The patterns and castings cost about $300, and 600 hours of labor was spent on it. The mill has been in use nearly



Example of Boring Mill Construction which proves that "Necessity is the Mother of Invention"

every day for the last seven years. It swings 36 inches and about 20 inches under the cross-head. The work is mostly on pumps such as are used by the farmers for irrigation purposes, and the mill is accurate enough for these pump parts. This boring mill is pretty good evidence that the Yankees do not all reside in the East.

* * *

NOMINATION OF A. S. M. E. OFFICERS

The nominating committee of the American Society of Mechanical Engineers has nominated the following officers for 1927: President, Charles M. Schwab, chairman, Bethlehem Steel Corporation; vice-presidents: Charles L. Newcomb, manager, Deane Works, Worthington Pump & Machinery Corporation; E. O. Eastwood, professor of mechanical engineering, University of Washington; Edwards R. Fish, vice-president, Heine Boiler Co.; managers: Paul Doty, chairman of board, Minnesota State Board of Registration; Ralph E. Flanders, manager, Jones & Lamson Machine Co.; Conrad N. Lauer, treasurer and general manager, Day & Zimmermann, Inc.; and treasurer, Erik Oberg, editor of MACHINERY.

MAKING USEFUL EQUIPMENT FROM OLD LATHE BEDS

By DONALD A. HAMPSON

The changed point of view toward machine tools of obsolete design, and the campaigns of replacement, have put countless tons of iron on the scrap heap that should have been there long before. Occasionally one of these old machines can be converted into a useful piece of equipment. Every shop, particularly every manufacturing shop, requires means for handling such odd jobs as bending, assembling, erecting and lay-out work for which no standard product is obtainable. The old lathe bed makes an exceptionally good foundation for equipment designed to handle this class of work. The following examples will serve to show what may be accomplished along these lines.

Extension Bed for Lathe

A small shop building a line of power transmission equipment acquired an old 28- by 20-inch lathe during war days, which was replaced later by a more modern machine. The discarded lathe was about to be sent to the junk heap when it was suggested that the bed might be put to some use. Accordingly it was cut apart nearly in the middle. Two vees were machined in the longer section to correspond with the tailstock vees of one of the shop lathes, after which it was lined up and bolted to the end of the lathe, thus making an extension on which the tailstock could be run out. Work on long shafting assemblies which necessitates cutting near the headstock end, but requires the use of only a tailstock and steadyrest beyond that point, can now be handled on the extension-bed lathe to much better advantage.

Shaft Straightener

The other part of the lathe bed was made into a shaft straightener. Two V-supports were fitted to the ways of the lathe. These supports could be moved or slid along the bed to give any desired spacing between the supporting points. A steel yoke, designed to clasp the lathe bed at the bottom and provided with a pressure screw at the top, was also fitted to the bed. The great depth of section in the lathe bed made this straightener particularly well adapted for heavy work.

Test Stand for Centrifugal Pumps

In another shop, several old lathe beds are in use in the testing department. The centrifugal pumps made at this shop can be hooked up very nicely to the cast-iron slabs used as permanent tops for the old lathe beds. The great mass of the lathe beds, combined with that of the surface plates, gives the stand sufficient rigidity to make them particularly well adapted for testing centrifugal pumps and the various attachments and accessories operated at high speeds. These test stands, which cost practically nothing except the labor spent in rigging them up, are really high-grade pieces of equipment.

Outboard Support for Planer

At still another shop, an old lathe bed is used as an outboard support for open-side planer work. In this shop a large number of long castings are required to be faced on the ends. The outboard supports originally used to carry the weight of the overhanging ends did not prove satisfactory, but all trouble from this source was eliminated by the new support made from the discarded lathe bed. The old bed was provided with a carriage mounted on grooved rollers supported by the V-ways. The lathe bed thus equipped was set on a concrete foundation and leveled up with wedges like those used for the planer.

Miscellaneous Uses for Old Lathe Beds

In a number of cases, old lathes have been stripped and the beds used for benches. Benches made in this way will support almost any weight that is placed upon them, and in addition leave a clear space below the bench. The usual method of converting an old lathe bed into a bench is to fasten maple planks or boards to the top.

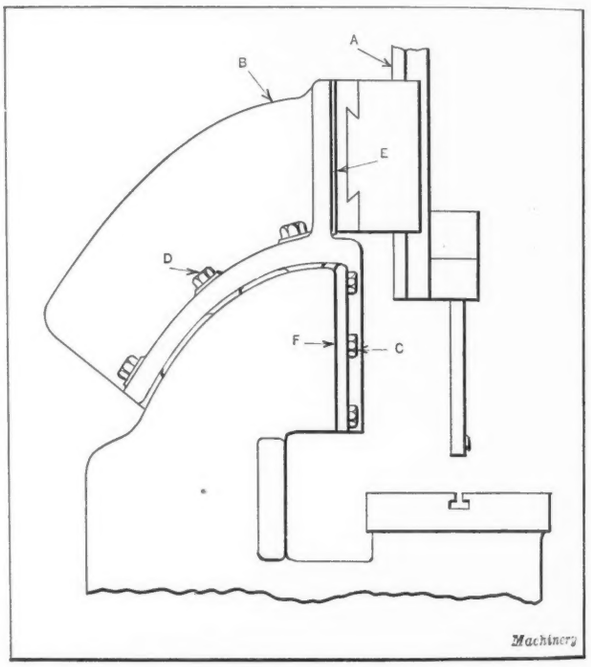
In one instance, a plumber obtained an old lathe bed and converted it into a threading bench, for which it proved ideally adapted. The heavy body and solid cast-iron legs are sufficiently rigid to prevent the shifting of the bench, or weaving, such as often proves troublesome in the case of benches constructed in the usual manner. Old lathe beds have also proved particularly useful as benches for the cast-iron surface plates employed in newspaper printing plants. These cast-iron plates, which are 28 inches wide, are often 10 feet in length, and obviously require a very rigid support.

* * *

VERTICAL TURRET LATHE EQUIPPED FOR DEEP BORING

By B. J. STERN

In the accompanying illustration, is shown a vertical turret lathe equipped for boring and facing valve castings having extra long bodies. The first step, in equipping the machine for the boring operations, was to remove the cross-rail casting and the saddle *A*. The cross-rail casting was then replaced by the casting *B*, which was secured in place by



Vertical Turret Lathe equipped for boring Valves having Long Bodies

bolts *C* and *D*. Casting *B* was machined at *E* to bring this surface in line with the finished face at *F*. The cross-rail casting and saddle were then mounted on the face *E*. By this arrangement, the range of the vertical movement of the spindle was increased 20 inches, thus making it possible to handle the valve boring operations on a production basis. It was necessary, of course, to lengthen the feed-shaft and to make other minor alterations.

* * *

MEETING OF AMERICAN SOCIETY FOR STEEL TREATING

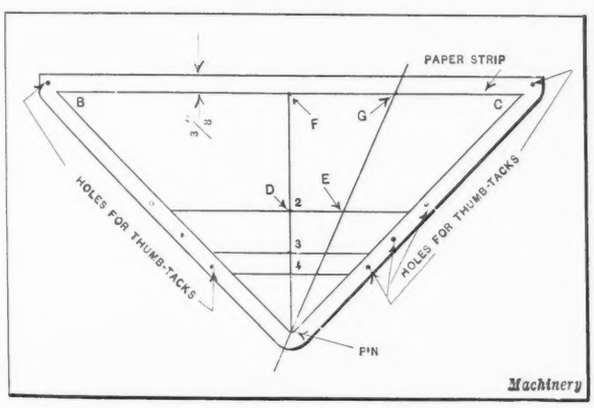
The eighth annual convention of the American Society for Steel Treating will be held in Chicago September 20 to 24 in conjunction with an extensive steel heat-treatment equipment and machine tool exposition. All the technical sessions of the convention will be held at the Drake Hotel, which will be the convention headquarters. The exhibit will be held at the Municipal Pier. It is expected that this exposition and convention will be the largest that the steel treating industry has ever held. In connection with the convention, there will also be a conference on metallurgical education. The 8000 square feet of exhibit space available in Chicago has already been reserved, indicating an unusually large exhibit.

MAKING ENLARGED OR REDUCED SCALE DRAWINGS

By DANIEL D. MOLONY

The writer has found the device shown in the accompanying illustration to be very useful in transferring to reduced or enlarged scale, the undimensioned spaces on drawings. It consists essentially of a triangular piece of celluloid with a pin marking the vertex of two triangles scribed on the celluloid. Parallel with the scribed base line *BC* are scribed the lines marked 2, 3, and 4. The line marked 2 intersects the vertical line at a distance above the vertex equal to one-half the altitude of the isosceles triangle formed by the two scribed triangles. The line marked 3 intersects the vertical line at a distance above the vertex equal to one-third the altitude of the triangle. On the 3/8-inch border outside the base line *BC*, a paper strip is fastened by means of thumbtacks, for which holes are provided as indicated. The inner edge of the paper strip is positioned to coincide with the base line *BC*.

When a drawing is to be made to an enlarged scale, the base corresponding to the desired ratio of enlargement is placed directly over the points to be replotted on the enlarged drawing. A straightedge is placed on the celluloid device in such a position that the edge is in contact with the vertex pin and at the same time passes through one of the points to be transferred. The properly enlarged dimension will then be indicated on the base line *BC*. For instance, let it be assumed that a copy of a drawing is to be made to a scale twice as large as the original. Placing the triangle over the drawing to be enlarged with the points *D* and *E* directly over the ends of the line to be transferred, we next place a



Device for Use in making Enlarged or Reduced Scale Copies of Drawings

straightedge in contact with the pin and in such a position that its edge passes through the point *E*. We now have the required enlarged dimension *FG* laid off directly on the base line *BC*.

To make a drawing to a reduced scale, the reverse procedure is followed. In the latter case, the strip of paper is fastened along the base line corresponding to the required reduction. For instance, if the drawing is to be made one-fourth the size of the original, we would select the base line marked 4. Then with the base line *BC* coinciding with the line on which the various points to be transferred are located, we employ a straightedge as described to transfer the corresponding points to the edge of the strip along line 4. All the dimensions or spaces to be transferred may be laid of on paper strips before beginning the new drawing, if desired. In order to eliminate mistakes or confusion in laying off the dimensions, each strip can be given an identifying mark or notation when marked off.

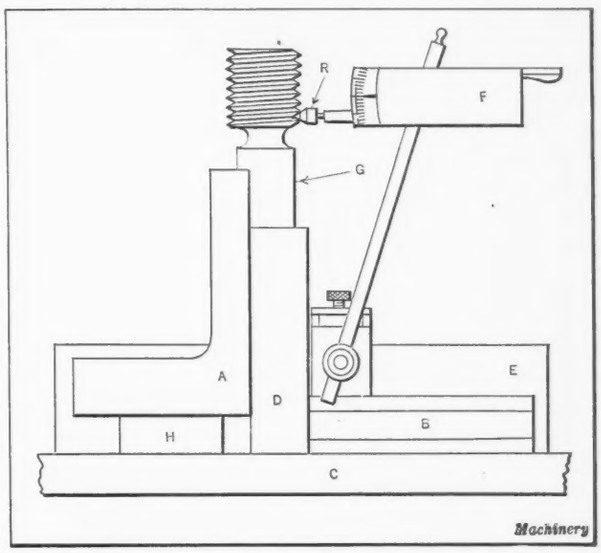
* * *

The increasing popularity of the closed motor car is well illustrated by some figures recently published by the General Motors Corporation. In 1922, only 28 per cent of the sales represented closed cars, while in 1925, 63 per cent, and in the first six months of 1926, nearly 80 per cent were closed cars.

TESTING LEAD OF THREADS

By CHARLES KUGLER

The method of testing the lead of a screw thread that is shown in the accompanying illustration is employed by the writer for thread gages that do not have centers at each end. Referring to the illustration, *A* is an angle-plate with a V-groove cut in one side. If an angle-plate of this kind is not



Method of testing Thread Lead

available, a V-block may be used. At *B* is the base of a surface gage which rests on the surface plate *C*. *D* and *E* are parallels, and *F* is an indicator.

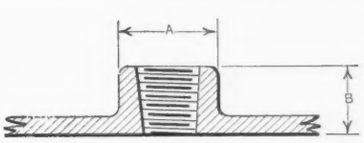
The parallel *E* is used as a guide for locating the angle-plate *A* and the base of gage *B*. The angle-plate *A*, to which the thread gage *G* is secured, rests on the gage-block *H*. After taking a reading of the indicator with the point *R* making proper contact with the thread to be tested, the gage-block *H* is removed and the angle-plate *A* lowered until it rests on the surface plate *C*.

The height of the gage-block *H* is determined by the distance between the number of threads to be tested. If the indicator shows no variation when brought into contact with the thread after the gage is lowered, the lead is considered correct. If there is an error in the lead, the exact amount of error will be shown by the indicator. If necessary, small C-clamps may be used to hold the parallel bars in position. As the parallel *E* serves to keep the surface gage lined up with the thread gage to be tested, there is no necessity for scribing a line along the top of the threads to serve as a guide in measuring the lead.

* * *

SIZES OF PIPE BOSSES IN CAST IRON

By EDWARD T. HEARD



Pipe Size	A	B	Pipe Size	A	B
1/4	1	3/8	1 1/4	2 1/2	11/16
3/8	1 1/8	7/16	1 1/2	2 3/4	13/16
1/2	1 7/16	1/2	2	3 3/8	7/8
3/4	1 3/4	9/16	2 1/2	4 1/8	1
1	2 1/16	5/8	3	4 3/4	1

A = Minimum size for safety.

The Machine-building Industries

WHILE the usual seasonal decline in production is noted in several industries, the first half of 1926 closed with productive activity at a high level, the credit situation generally being easy and consumption demand large. The steel industry, having declined from its high peak in March, has since then held up unusually well, averaging about 80 per cent of capacity. A survey made by the National Association of Manufacturers, covering the maximum employment capacity of thirty basic groups of industry, shows these groups operating at 84 per cent of capacity. Car loadings are again on the increase, exceeding one million cars per week. Of the major industries, serious reduction of output is noted only in the New England textile mills. The Federal Reserve Board reports a gain in wholesale and retail trade over the volume of a year ago. The retail trade in the five months ended in May, which is the last month for which complete statistics are now available, sets a new high record for all time.

The steady refusal of the iron and steel industry to enter a real seasonal slump, which is long past due, continues to puzzle forecasters of business conditions, as the expected curve of the business cycle is by no means being adhered to. Instead of a decline, heavier buying of iron and steel for third-quarter needs is reported in all sections. The railroads have increased their purchases, and steel bar and sheet steel demand has held up unusually well. Late in June the falling off in sales of structural steel was apparently not considered very serious by the leading mills, who announced a two-dollar advance in price on standard structural shapes.

According to the reports presented at the meeting of the Atlantic States Shippers' Advisory Board on July 8 at Atlantic City—a meeting attended by over 500 shippers and railroad officials in the eastern states—business for the third quarter of 1926 will, in general, continue at about the same volume as for the corresponding period of 1925. According to the summary presented by the board, there will be a moderate increase over the corresponding period a year ago in the machinery industry. The iron and steel industry and the automotive parts industry may be expected to operate at about the same level as a year ago. It is also stated that New York, Pennsylvania, and New Jersey lead in building permits on the Atlantic coast, and that prospects for building construction continue good, although it may be expected that the pace will moderate somewhat.

At the Midwest Shippers' Advisory Board meeting held July 14 at Davenport, Iowa, it was reported that in this district, increased business in the next three months, compared with the corresponding period of 1925, may be expected in several industries, including iron and steel products.

The volume of building construction is substantially larger than a year ago, although the trend is downward, especially in speculative housing construction. The contracts awarded in June are estimated at $237,625,000 as compared with $203,479,000 in June a year ago. The contracts let during the first six months of the year, according to the *Engineering News Record*, totalled $1,360,000,000 as compared with $1,138,000,000 for the same period a year ago.

The Machine Tool Industry

The reduced demand characteristic of the summer months is in evidence in the machine tool industry, but on the whole, business in this field shows an improvement over several years past. Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, states that ever since January, 1925, machine tool orders have been considerably above the average for the three years 1922, 1923, and 1924. "No one can prophesy," says Mr. DuBrul, "how long the demand is likely to continue above this average, and the experienced machine tool man does not expect a continuously rising trend; therefore, he has not been surprised to find that the demand curve has taken a downward trend during the last few months." While there has been a reduction in general employment in the industries, a number of machine tool manufacturers state that there is a scarcity of skilled mechanics.

The Iron and Steel Industry

While there has been a seasonal decline in the iron and steel industry, the mills are, nevertheless, operating to a greater extent than at the corresponding period in 1924 and 1925. A revival of confidence in this industry has been apparent for nearly two months, after a period of uncertainty and hesitation. The Federal Reserve Bank of Cleveland points out that consumption is holding up much better than was expected, and that it is well ahead of what might be considered normal at this time of the year. Buyers are disposed to cover their estimated future needs more freely.

A big factor in the increased buying has been the comparative stability of prices. As a result, the operating conditions of the steel mills have been good, running at about 80 per cent of the steel ingot capacity. In June, 1925, production had been reduced to 65 per cent, and was still falling; yet in that year the greatest total steel output in the history of the country was established. The figures for steel output in May, the last month for which complete statistics are available, show a production of nearly 85 per cent of the theoretical capacity, as against 88 per cent during April; but the May tonnage was over 14 per cent ahead of the same month in 1925. The steel production in June is estimated to have fallen about 5 per cent below the output in May, but it was approximately 14 per cent ahead of the corresponding month a year ago, while the output for the first six months is the largest in the history of the American steel industry, and exceeds the record output of the corresponding months in 1925 by nearly 8 per cent. On the first of July, 220 of the country's 369 blast furnaces were in operation, which is slightly below the theoretical normal of 60 per cent.

The Automobile Industry

The production of automobiles, as usual, is declining at this time of the year, preparations for many new models being under way. The July production, therefore, is likely to be appreciably below that of recent months, but it is expected that higher schedules will be resumed in August. Satisfactory conditions are reported throughout the industry, the demand for both new and used cars keeping up well. *Commerce and Finance* points out that stocks of new cars are moderate, and that if the sale of used cars continues as active as it is at present, throughout the summer months, the industry will remain in a fine condition in the fall. The General Motors sales to consumers were thought to have reached the peak in April, but May sales considerably exceeded those of the previous months, and the sales since that time have far exceeded those of a year ago. Several other automobile companies, including Dodge Brothers, report the biggest business in their history.

Railroad traffic remains heavy. The greatest freight traffic that the railroads of this country were ever called upon to move in any corresponding period was handled without difficulty during the first half of this year. The number of net ton miles showed an increase of 6 per cent over the corresponding period of last year, and an increase of nearly 9 per cent over the corresponding period of 1924. No car shortage is reported, the heavy freight being handled without any difficulty.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

CINCINNATI BICKFORD PLATE AND RIVET HOLE DRILLER

A drilling machine of a special heavy radial type has recently been developed by the Cincinnati Bickford Tool Co., Cincinnati, Ohio, particularly for use in boiler, tank, and structural shops. With this machine large quantities of duplicate plates can be quickly drilled. The base of the machine is mounted on wheels and arranged for traveling under power on a track placed parallel to a bench or trestle on which are stacked the plates to be drilled. The bench should be long enough to support two stacks, end to end, of the longest plates handled in the shop. Then, while one stack is being drilled, another stack may be set up on the opposite end of the bench so that they can be drilled without loss of time as soon as the first stack is completed.

As many plates may be stacked on each other as the length of the twist drill being used will permit. The practice is to use a plate from a previously drilled lot as a templet. With this method, the laying out of holes is practically eliminated when large quantities of duplicate plates are being drilled. In drilling 1/4-inch plates, a production of 800 holes of 11/16-inch diameter has been maintained per hour. Only one man is required to operate the machine, the usual labor gang being employed only in stacking new plates and removing drilled ones. In addition to high-production, further economies are realized in erecting the work in the field. Reaming is practically eliminated, because of the method of duplicating holes with straight sides.

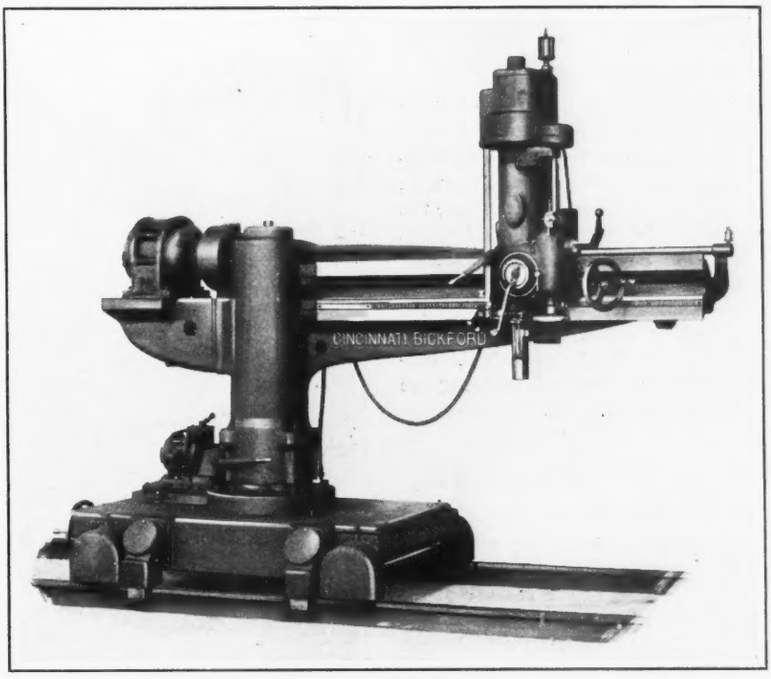


Fig. 1. Cincinnati Bickford Heavy-type Plate and Rivet Hole Driller

While the arm of the machine is of large proportions, it may be swung with one finger, and so the twist drill can be positioned over the plates with a minimum of time and effort. This feature is obtained through the use of large-diameter hardened steel rollers which bear on a hardened and ground steel ring on the column. The driving motor can be of 10 or 15 horsepower, and is supported on an extension of the arm. The latter can be furnished in 4-, 5-, 6-, or 7-foot lengths to suit the maximum width of plate handled. The arm swings on a column which is secured to the base by means of a heavy flange. Provision is made on the lower part of the column for clamping the arm rigidly in position while drilling. A large amount of clamping surface insures against any side movement of the arm, and this is an important factor in preventing drill breakage.

A hand-lever is furnished as standard equipment for clamping the arm to the column, but the machine can be provided with either an electric or a compressed air clamping device. With the electric type, the arm is clamped by means of a small motor, and with the compressed air type, by a double-acting air cylinder. The control of both types is located on the head near the spindle, so that the operator can clamp and unclamp the arm without leaving his position at the head.

The large handwheel on the right-hand side of the head is employed to move the head along the arm. The movement is 1 1/4 inches per revolution of the handwheel. About one-eighth of a revolution is lost motion, which provides a hammer effect for the fine adjustment of the head along the arm, whereby an accurate alignment of the drill is quickly obtained with the holes in the templet. Quadruple back-gears in the head, of the selective sliding type, combine with a variable-speed direct-current or a multiple-speed alternating-current driving motor to give a desirable range of spindle speeds for plate drilling. Closely graded feeds permit of working drills up to the limit of their capacity. Clutches for starting, stopping, and reversing the spindle are operated through a lever conveniently located at the right of the spindle. These clutches are fully enclosed, run in oil, and can be easily adjusted. The spindle is made of a special alloy steel having an ultimate tensile strength of approximately 200,000 pounds per square inch. The feed rack and pinion are made of the same material. Ball thrust bearings are furnished at both the top and bottom of the spindle sleeve.

A trip automatically disengages the power feed when the drill penetrates the bottom plate of a stack. This trip acts directly on the main feed clutch. A countersinking attachment can be furnished by means of which the operator can position the head and arm with one hand and countersink with the other. The attachment consists of a long lever fastened to the feed pinion shaft, which provides a lever feed to the spindle.

The machine may be locked to the rails by means of four clamps located near the wheels. These clamps grip both sides of the rail-head and are operated in unison through a large handwheel. An equalizing system insures uniform gripping of the four clamps. A two-horsepower constant-speed motor mounted on the base furnishes power for propelling the machine along the track. This motor is geared directly to the axle through a worm drive, and is controlled by means of a reversing drum-type controller. When the traveling feature is not desired, the machine can be equipped with either of two stationary bases—a short base which merely

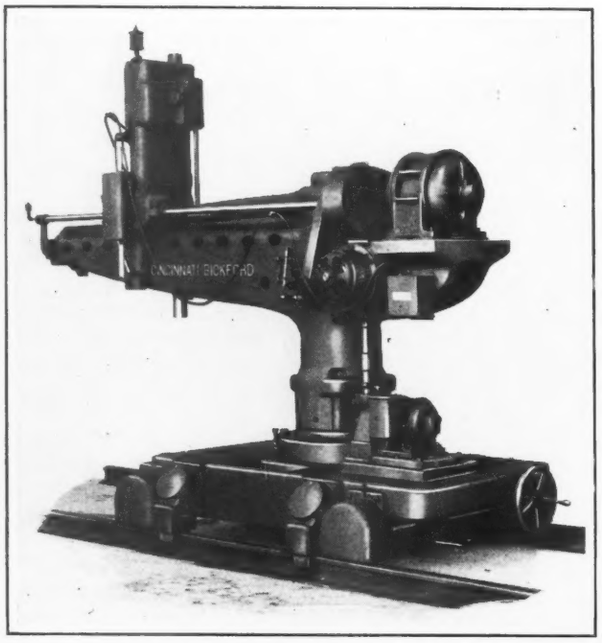


Fig. 2. Rear View of the Plate and Rivet Hole Driller

serves as an anchorage or a standard radial drilling machine base having a large working surface provided with T-slots.

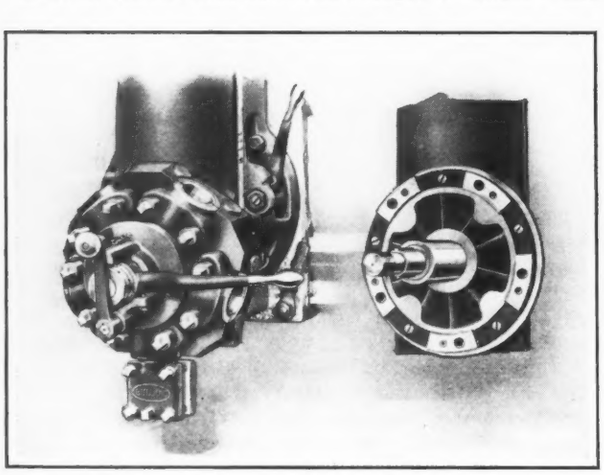
In some shops, it may be preferable to have one man operate two machines located on opposite sides of the bench on which the plates are stacked. For such an arrangement, the machines can be equipped with right- and left-hand arms, in order to reduce to a minimum the distance traversed by the operator in going from one machine to another. If in addition to plate drilling, the machine is to be used on a general class of work, a standard radial drilling machine mounted on a track type of base can also be furnished. Provision is made on this machine for raising and lowering the arm to accommodate various heights of work.

BULLARD VERTICAL TURRET LATHE IMPROVEMENTS

Several changes and improvements have recently been made in the line of vertical turret lathes built by the Bullard Machine Tool Co., Bridgeport, Conn. The bed casting of all machines has been strengthened, and finished pads are now provided on the bed for supporting a forming attachment bracket for the side-head. The forming attachment is made in two types—a plate type which is intended for use in crowning pulleys and machining similar contours, and a universal type, which may be set to cover a wide range of angles such as is required in machining bevel gears.

Material specifications have been changed to include a cast-steel main slide, an all-steel turret, and a steel side-head slide. An important change in the turret construction consists of the locking mechanism. This comprises two steel rings, which are screwed and doweled to the inner side of the turret and the face of the main slide. One of these rings may be seen at the right in the accompanying illustration. Each ring is provided with five pairs of opposed bevel surfaces which mesh positively at the five points of turret registry. In addition to the greater strength and accuracy which this construction provides, the mating of the rings on opposed bevel surfaces assures a longer life of the parts.

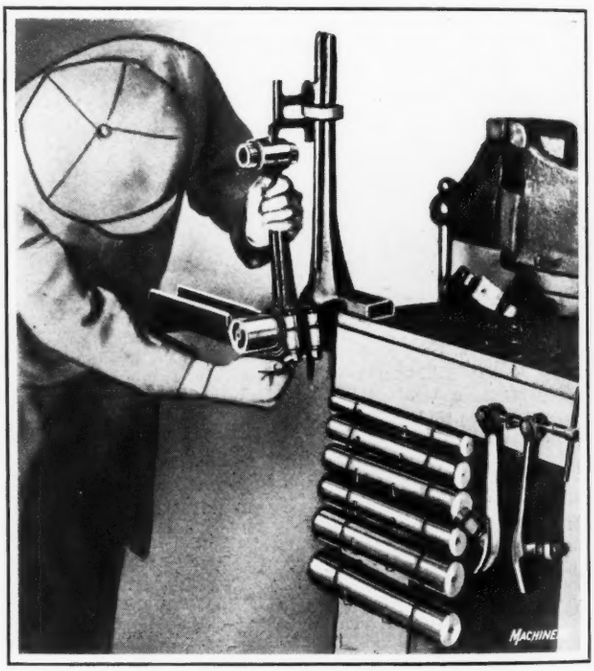
Alemite Zerk pressure oil-gun lubrication has been adopted for all bearings in external units which do not have a fixed relation to the bed and in which the bearings cannot be reached by oil from the constant-flow system or from other unit reservoirs.



Construction of Turret on Bullard Vertical Turret Lathes

WILKIE CONNECTING-ROD GAGE AND STRAIGHTENER

A connecting-rod gage of new design, with arbors and straighteners, has recently been placed on the market by the Continental Machine Co., 1301-1303 Washington Ave., South, Minneapolis, Minn. For the bending test, the rod is placed vertically in the device, and any error that may exist is observed between the wrist-pin and the testing plate. The error is corrected by merely tightening a set-screw of a universal bender.



Wilkie Connecting-rod Gage and Straightener

The rod is placed in the horizontal position for testing the amount of twist, and this can be observed between the wrist-pin and the ways of the device. Elimination of the twist is accomplished by merely turning a set-screw on a universal twister. The device can also be used for determining whether or not the wrist-pin holes of pistons are bored square with the sides, and for making initial tests on connecting-rod and piston assemblies.

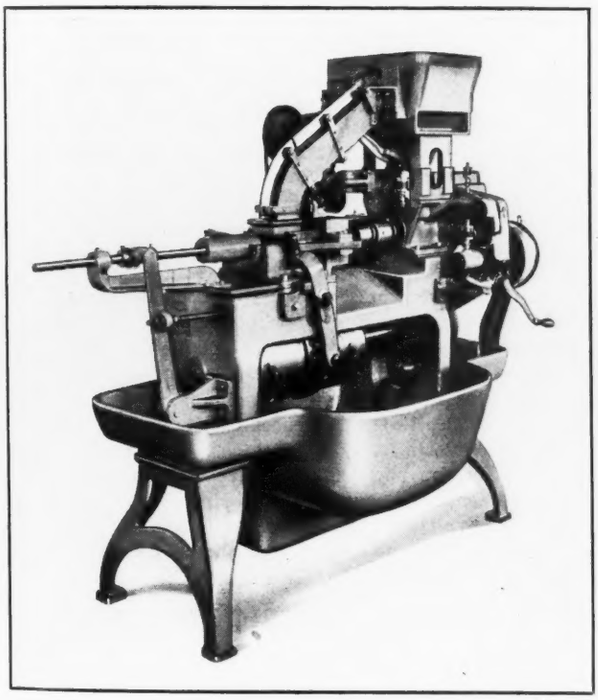
KENT CAP-SCREW AND BOLT THREADING MACHINE

An automatic cap-screw and bolt threading machine has recently been placed on the market in two sizes by the Kent Machine Co., 268 N. Water St., Kent, Ohio. Each size is readily adjustable to accommodate the range of work within its capacity. The smaller machine is designed for cap-screws

up to 1/2 inch in diameter and up to 3 1/4 inches in length under the head; it will thread the body of screws for a length of 2 1/2 inches. Screws over 1/2 inch in diameter and up to 4 inches in length under the head are handled by the larger machine, which also cuts threads up to 2 1/2 inches long.

The hopper feed of each machine is so designed that the only change needed to suit different sizes of screws is to replace the agitating plate in the center of the hopper. Plates are furnished with the machine to suit the range, and these plates are readily attached and detached, so that the change from one plate to another can be made in a few minutes. The delivery chute from the hopper to the machine proper is adjustable within the range of the machine. When the machine is used for threading cap-screws, this chute delivers each blank to a carrier, from which it is transferred to holding jaws for the threading operation. The cap-screw is held by the head, and an internal trip on the die-head regulates the length of thread cut. In threading bolts, the method of feeding is similar, but the bolt is held by the shank in the clamping jaws, thereby insuring a thread concentric with the shank.

After a blank has been fed into the threading position, the spindle that carries the die-head is automatically advanced

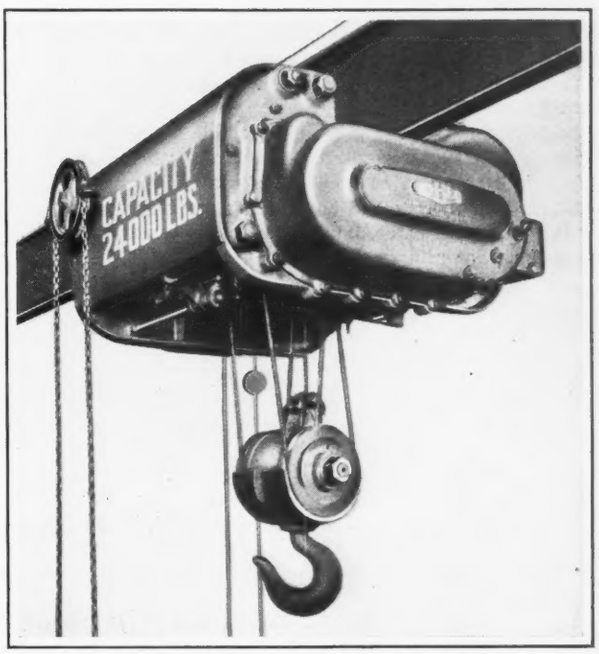


Kent Automatic Machine for threading Cap-screws and Bolts

for the operation. When the screw or bolt has been threaded to the desired length and the die-head automatically opened and backed off the blank, the gripping jaws are automatically released and the finished product is then ejected from the threading position by a new blank. The action of threading and ejecting is rapid, and so there is practically no "air-cutting" time. The machine is driven by belt from a countershaft.

"LO-HED" ELECTRIC HOISTS

Six "Lo-Hed" electric monorail hoists, ranging in capacity from 3 to 12 tons, have just been added to the line manufactured by the American Engineering Co., Philadelphia, Pa. Each hoist is made in bolt-suspension, hand-geared trolley, motor-trolley and cab-control types. Push-button, remote, or foundry-type controls can also be provided. Open cabs are furnished for indoor use, and closed cabs for outside service. The new hoists are designated as "Class J," and embody the same principles of design as the other models of "Lo-Hed" hoists built by this company, with such additional features



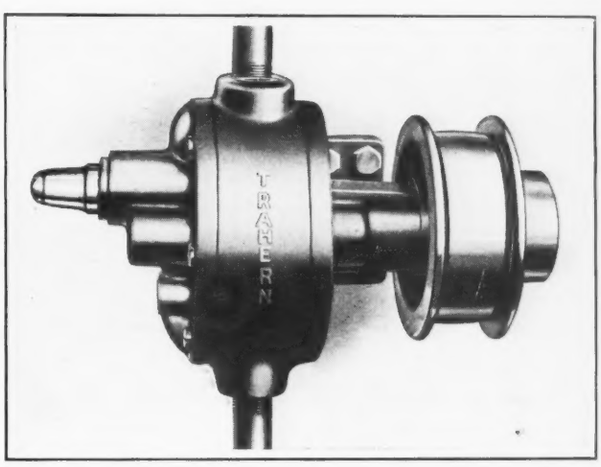
"Lo-Hed" Electric Monorail Hoist

as are necessitated by the higher speeds at which the hoists operate and the heavier loads they are designed to handle.

The drum and motor are placed on opposite sides of the I-beam track, so that the load block can be drawn up between them until it almost touches the beam. This utilizes the available head room, and enables the hoists to handle larger loads and stack parts higher than would otherwise be possible. Hyatt roller bearings are provided in the trolley wheels, and ball thrust bearings between the wheels and the trolley frames. The hoisting motor is equipped with ball bearings, is totally enclosed, and drives the drum through spur gears, which run in oil. A quick-acting brake is automatically applied the instant the current is turned off, either accidentally or intentionally, and stops all movement of the load without drift.

TRAHERN REVERSIBLE COOLANT PUMP

A Trahern reversible pump has recently been placed on the market by the George D. Roper Corporation, Rockford, Ill., for pumping cooling water, oil, or compound on metal-working machines. A feature of this pump is the pulley drive construction. All strain due to belt pull is eliminated from the driving shaft by the use of an extended bearing or hub, which is cast integral with the back plate around which the pulley revolves. The pump will reverse automatically with the machine on which it is installed.



Trahern Belt-driven Reversible Coolant Pump

A relief valve built into the faceplate obviates the necessity of installing an independent valve in the line. This relief valve automatically by-passes all excess flow of liquid and may be used as a complete unloader for the pump, regardless of the direction of pump rotation. The pump is especially adapted for use on reversible metal-working machines, such as screw machines, turret lathes, bolt-cutters, etc., but it can also be used on one-way equipment, such as milling, gear-cutting and bolt-cutting machines. Four sizes of the pump are made, having capacities ranging from 1 to 26 gallons per minute.

CINCINNATI RAPID-TRAVERSE SIDE-HEAD BORING MILL

A 6-foot boring mill equipped with a rapid power traverse side-head constitutes the latest development of the Cincinnati Planer Co., Cincinnati, Ohio. The side-head is designed to permit machining work of any height within the capacity of the mill, and its ram can reach almost to the center of the table. With this third head on a boring mill, boring, facing, and turning cuts can be taken at one time. Power can be used for feeding the head up or down or the ram toward the work.

The side-head has a rapid power traverse in all directions, power being obtained through an individual motor placed on the right-hand housing. This motor is controlled by shifting the lever of a drum controller. As the rapid power traverse lever is thrown in, the feed is automatically disengaged. The side-head does not interfere with the operation of the rapid traverse lever for the rail heads.

The speed-change levers for the table have been brought to the front of the machine in front of the side-head, where they are convenient to the operator, and the starting and stopping levers have also been brought into the same location. A narrow guide has been embodied in the construction of the side-head to eliminate twisting, and the face of the right-hand housing has been considerably increased in width to give a rigid housing, which makes it possible to run the side-head up to the extreme position and still take heavy cuts. The ram is made of cast iron, and has a steel rack bolted to it. In case of an accident, it is an easy matter to replace the rack without scrapping the entire ram. The side-head can be provided with a taper attachment, as shown in Fig. 2, or with a crowning attachment. A thread-cutting attachment can also be furnished.

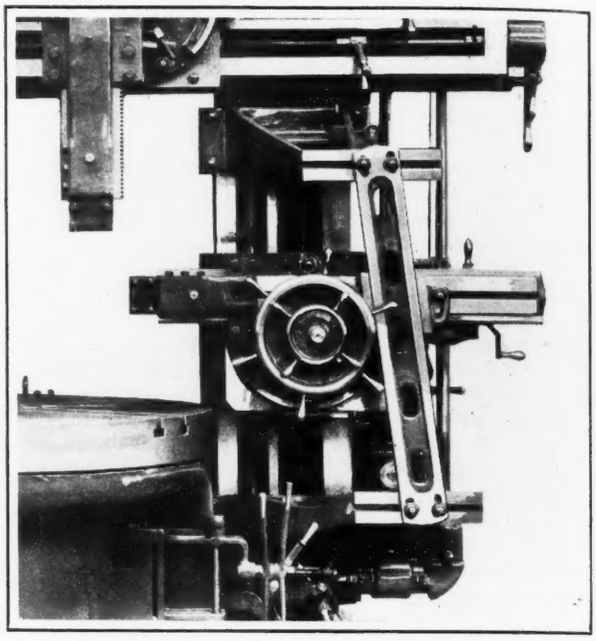


Fig. 2. Side-head provided with the Taper Attachment

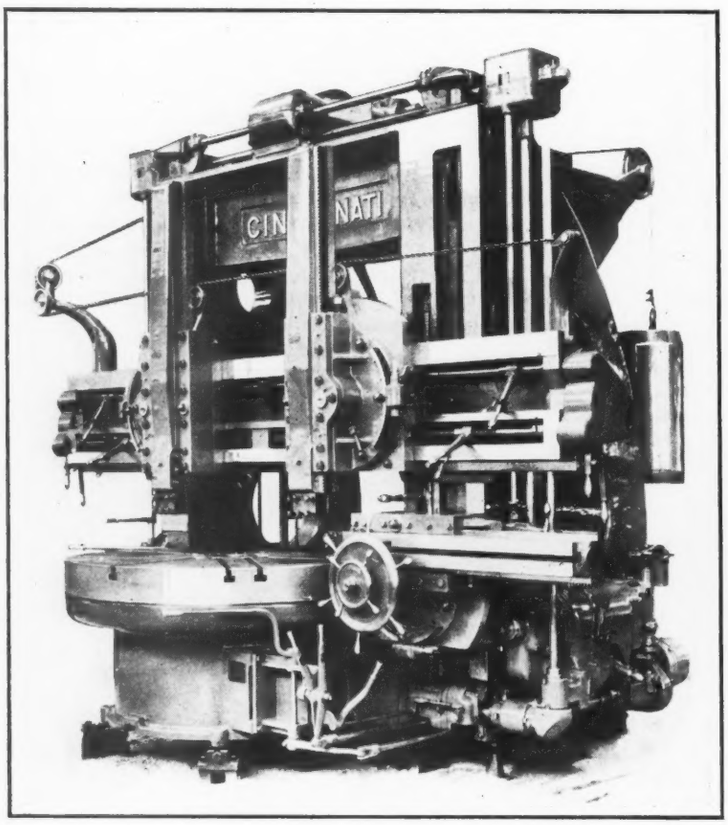


Fig. 1. Cincinnati Boring Mill equipped with a Power Rapid Traverse Side-head

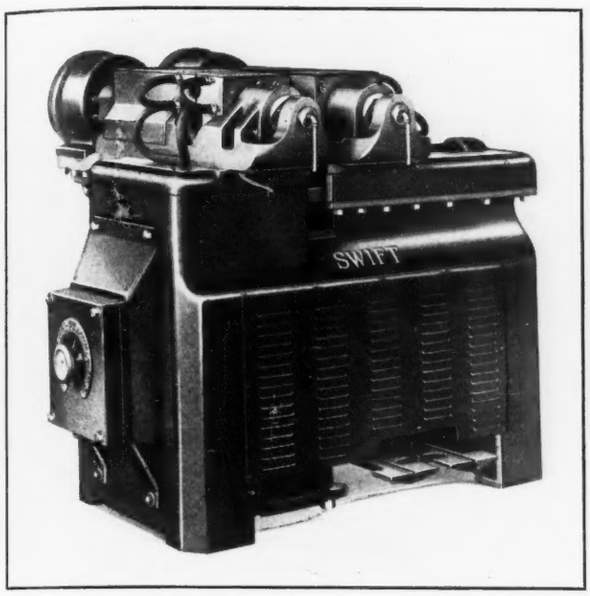
"ROLLWAY" PUMP IMPROVEMENTS

Several improvements have been made in the construction of the "Rollway" pump manufactured by the Universal Standard Sales Co., Woodward at Grand, Detroit, Mich. This pump was described in April, 1923, MACHINERY. Formerly, the pump was furnished with aluminum rollers, and some difficulties were encountered from the rollers "freezing up" with chips. The special bronze rollers now provided have eliminated these difficulties. For pumping dirty water and corrosive substances, the pump is now equipped with rollers made of a special monel metal.

SWIFT ELECTRIC FLUE WELDER

The exclusive selling rights for an electric flue welder recently developed by the Swift Electric Welder Co. have been taken over by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. This machine was designed for "safe-ending" flues and for reclaiming small pieces. Equipped with proper dies, it can be used for any kind of butt-welding. The machine may also be used for welding round or bar stock or for annealing, upsetting, heating, stretching, etc. The welder is said to be flash-proof, which insures long life to the windings and bearings. All moving surfaces slide on hardened and ground steel plates.

The clamps are of an improved flash- and slag-proof adjustable type, and slide on hardened steel guide plates. Foot-operated air cylinders leave the hands of the operator free for handling the work. Three-quarters of a cubic foot of air at a pressure of approximately 80 pounds per square inch is required for a weld. Two pairs of dies are used for each set, one set handling work on both 2- and 3-inch tubes. On the larger work, a separate set of dies is required for each size of flue. All dies are water-cooled, and are provided with hardened steel guide plates.



Electric Flue Welder placed on the Market by Joseph T. Ryerson & Son, Inc.

The machine is equipped with a pressure cylinder for pushing up the work. This cylinder may be connected to either a hydraulic accumulator, Oilgear pump, or a hand-operated oil jack. A pressure of 800 pounds per square inch is required for 6-inch tubes, and a pressure proportionately less for smaller work. The welder is operated by a remote control system, which consists of a contactor panel separately mounted and operated from a lighting circuit by a push-button switch located on the welder. The machine can be supplied for either 220-, 440-, or 550-volt current, preferably of 60 cycles, for the primary circuit. This circuit is air-cooled, and the secondary circuit is water-cooled. Boiler flues and superheater tubes of any size up to 6 inches in diameter can be handled in this machine.

"RED-E-HALL" PORTABLE ELECTRIC PIPE MACHINE

A portable motor-driven machine designed for threading, reaming, and cutting off pipe has recently been placed on the market by Hall-Will, Inc., Erie, Pa. Pipe from 1/4 to 2 inches can be handled, and bolts from 1/2 to 1 1/2 inches. The machine can also be used as a power unit for driving hand stocks up to 12 inches, through a universal shaft. Portability of the equipment is obtained through a built-in truck, the rear feet of the machine being mounted on small wheels. Double swivel castors located at the front of the machine elevate this end instantly as the handle is moved forward. When the machine is not moved frequently, the truck, wheels, and castors can be dismantled within three minutes.

A friction clutch for starting and stopping is operated by means of a lever handle on top of the machine. This feature facilitates the checking of threads, trying on of fittings, and screwing up of parts. There is a silent chain drive between the motor and the machine. The motor is of 1 horsepower capacity, runs at 1750 revolutions per minute, and is reversible. It is bolted direct to the main frame at the tailstock end, as may be seen in Fig. 2, where it is easily accessible for adjustment and oiling. A push- or turn-button control for starting, stopping, and reversing the machine is attached to the front of the bed. Timken roller bearings are furnished for all drive shafts, and all gears and shafts run in oil. Three speeds of operation are available, speed changes being made through a selective slide system of gears.

Close nipples can be threaded without extra equipment, using only the standard chuck. The lever handle on top of the die-head is manipulated to open and close the dies. When the die-head has once been set to a given size, it can always be brought back to the same size by pulling down the lever into the locking position. Adjustment for over-size and under-size threads is made by turning two nuts. Graduations and markers facilitate setting the die-head for various sizes of pipe. A locking device guards against the head opening or slipping while a thread is being cut. Cutting oil is forced into a chamber in the die-head, from which three outlets distribute it directly to the dies.

The cut-off attachment is a new type, in which the ways and support for the V-block are cast solid with the die-head. The cut-off block is mounted on the front V-block, a taper gib insuring proper adjustment of the tool-block to keep it steady at all times. Rapid operation of the cut-off tool is obtained through a handle on the cut-off screw. Double opposed V-blocks equipped with interchangeable hardened tool-steel plates hold the pipe steady while it is being cut off. The rear block opposite the cut-off blade is made extra wide, as this block takes most of the thrust and wear resulting from the cut-off tool. These V-blocks are operated through a handle on the rear side of the machine, which is fastened to a right- and left-hand screw. A reamer and chamfer lever is mounted on the cut-off block.

The oil pump is of the rotary geared type, is reversible, and is driven direct through a constant-speed motor. This machine will cut both right- and left-hand threads. Four sets of chasers cover the complete range. The weight of the machine is approximately 450 pounds.

DEFIANCE SIX-SPINDLE TAPPING MACHINE

A six-spindle single-purpose machine designed for simultaneously tapping all the spark plug holes in automobile cylinder heads or similar work is the latest development of the Defiance Machine Works, Defiance, Ohio. The production obtained with this machine ranges from thirty to forty-five tapped heads per hour. The spindles are mounted at fixed center distances in a head that slides vertically on the face of the column. Four, six, or eight spindles can be provided, and they may be spaced to meet requirements.

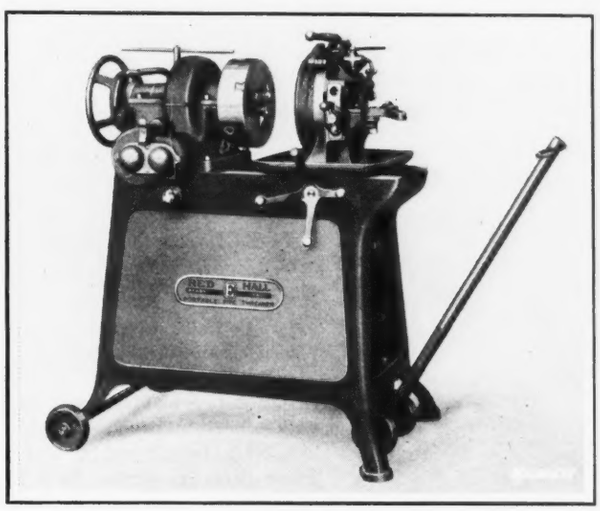


Fig. 1. Portable Motor-driven Pipe Machine brought out by Hall-Will, Inc.

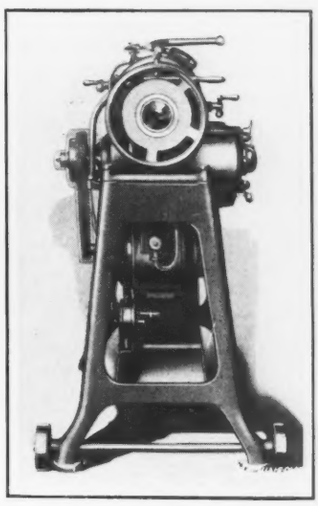
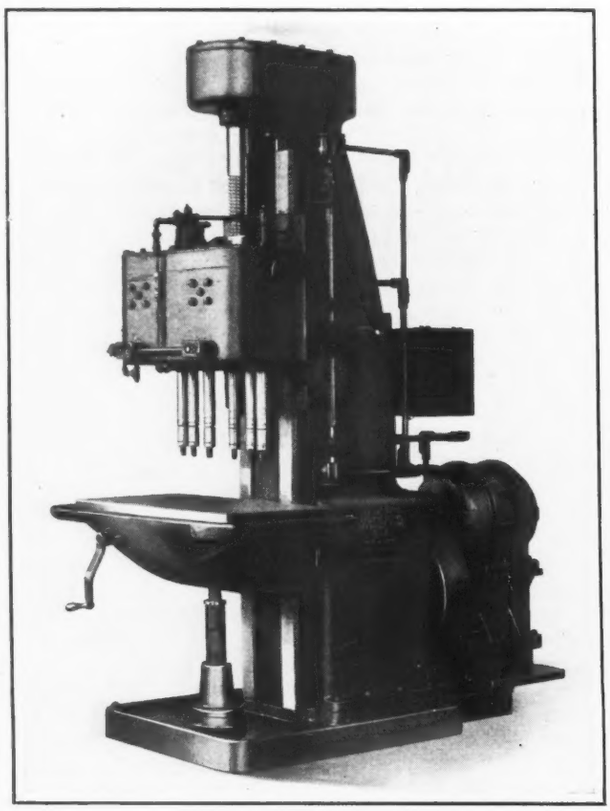


Fig. 2. Tailstock End of Pipe Machine



Defiance Six-spindle Fixed-center Tapping Machine

The feed mechanism operates the tapping head up and down by means of a screw. The feed-gears are selected to correspond with the number of threads per inch in the holes to be tapped. Stopping or reversing of the spindle head may be accomplished instantly at any position of either the up or down stroke. The head reverses automatically at the bottom of the down stroke, and stops at the end of the up stroke. Adjustable stops can be set to regulate the travel of the head from 2 to 12 inches. The machine is equipped only for a direct-connected motor drive, a 10-horsepower reversible motor being recommended by the manufacturer.

Some of the important specifications of this machine are as follows: Working surface of table, 20 by 36 inches; maximum distance from nose of spindle to top of table, 32 inches; distance from center of spindle to face of column, 8 inches; and maximum travel of head, 12 inches. The four-spindle machine weighs about 5800 pounds, the six-spindle machine, 6000 pounds, and the eight-spindle machine, 6200 pounds.

"FLEXTOL" ELECTRIC HAND TOOLS

Screwdriving, nut-setting, drilling, boring, grinding, buffing, and other operations can be performed by means of two "Flextol" hand tools recently placed on the American market by J. C. Edgecumbe & Co., 149 Broadway, New York City. The type A tool shown in Fig. 1 is intended for driving all sizes of wood and metal screws up to 5/16 inch, setting nuts up to 5/8 inch, and drilling holes up to 1 inch in wood and 3/8 inch in metal.

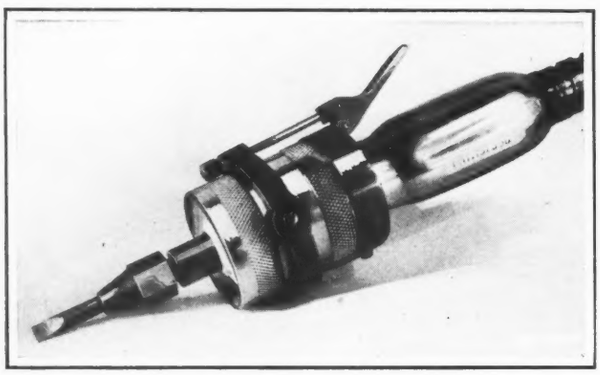


Fig. 1. "Flextol" Type A Tool for Drilling, Screwdriving, and Nut-setting Operations

The type B tool illustrated at *A*, Fig. 2, is designed for drilling holes up to 1/4 inch in wood and metal, and for grinding and polishing. The power unit for each type consists of a motor of from 1/4 to 1/3 horsepower, running at 1400 or more revolutions per minute, which may be suspended vertically in a convenient place. A flexible shaft coupled to the armature of the motor transmits the power to the tools. In addition to the vertical suspension of the motor and flexible shaft, a horizontal drive may be employed to give a greater radius of action. The device illustrated at *C*, Fig. 2, facilitates using the tools at any angle.

In the type A tool, a speed reduction of 5 to 1 is obtained through epicyclic friction cones, with the result that screwdrivers, nut-setters, or drills are driven at 280 revolutions per minute. With this tool, when the motor switch is closed, the drill chuck does not start rotating until pressure is applied on the tool. This is a distinct advantage in driving screws or setting nuts. The epicyclic cones are made of hardened steel, and ground. The sun cone has an extended

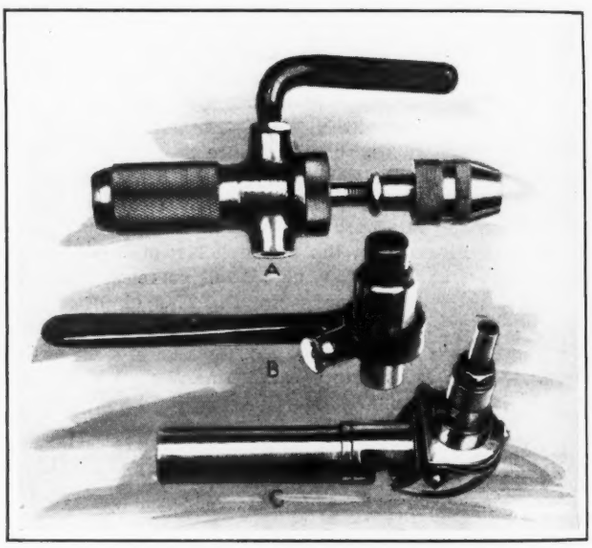


Fig. 2. (A) Type B Hand Tool; (B) Nut-setting Attachment; (C) Universal Joint

shaft, which is slotted for a portion of its length, and attached to the flexible shaft through driving pins. The nut-setting attachment used with the type A tool is shown at *B*, Fig. 2. This tool weighs 2 1/2 pounds, while the type B tool weighs 2 1/4 pounds. The type B tool is run at the motor speed, and is furnished with a three-jaw chuck and emery and buffing wheels. The principal advantages mentioned for these tools are that they are sufficiently light to be used with one hand, of such a small diameter that they can be used in corners and other inconvenient places, and so designed that they can be used at any angle.

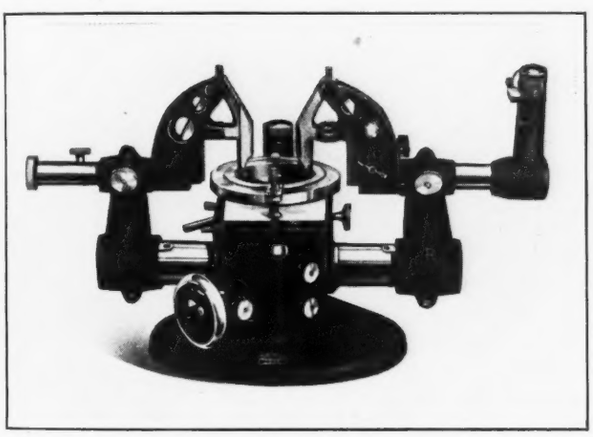
ZEISS HORIZONTAL "OPTIMETER"

A horizontal "Optimeter" which, in combination with an inside measuring attachment, may be used for making both external and internal measurements, has recently been placed on the market by the George Scherr Co., 142 Liberty St., New York City. This horizontal type incorporates all the essential features of the vertical "Optimeter" equipped with a horizontal attachment, which was illustrated in October, 1924, MACHINERY, but the new instrument covers a much wider range of work. It is particularly useful for makers of plug gages, measuring disks, spherical end rods, etc., and for both makers and users of ball and roller bearings. Equipped with the inside measuring attachment, the bore of

ball races and ring gages, and the width between snap gage jaws can be conveniently checked. The inside measuring attachment will be described in the following.

As clearly seen in the illustration, the bracket of the left-hand jaw is held by the tailstock, which is provided with a coarse and fine adjustment. The bracket of the right-hand jaw is attached to the optical tube. Both brackets contain pivots for the adjustable measuring jaws. One end of the left-hand jaw bears against the tailstock, and one end of the right-hand jaw against the feeler of the optical tube, as the feelers of the opposite ends of the two jaws are brought into contact with the bore of the ring or jaws of the gage being checked. The optical tube is graduated to 0.00005 inch.

Since the "Optimeter" is made expressly for measuring by comparison, the measuring jaws must be set to the nominal diameter of the part to be inspected by means of a snap gage built up from gage-blocks or by means of gage-blocks alone. In the former case, the outside feeler points of the measuring jaws are set directly to zero from the faces of the snap gage. In the latter case, a gage-block equal to the nominal size, less the sum of the lengths of both feeler points, is placed between the inside ends of the points, after which the optical tube is adjusted to zero. A reversal of the direction of the measuring pressure is required, according to whether the inside or outside points are used, and this reversal is obtained through a switch lever.



Zeiss "Optimeter" equipped with Jaws for making Internal and External Measurements

The part to be inspected may be placed on the table, and the latter raised until the measuring points come in contact with the proper surfaces, at which time the deviation of the part from the nominal size may be seen in the optical tube. It is, of course, necessary to move the part until the maximum diameter has been located beyond doubt. This is accomplished by means of a compound table motion, the lower slide floating on balls in the direction of the measuring pressure, while the upper slide is traversed crosswise by means of a rack and pinion.

The vertical adjustment of the table permits the checking of bores and plugs at various heights or for taper. A swivel motion of the table is also provided to facilitate adjustment of the measuring jaws to a snap gage built up from gage-blocks. Both the feeler points of the jaws and the jaws themselves are readily interchanged. This is an important feature, because special feelers and jaws are used for small bores and for such parts as ball races. Parts can readily be checked within an accuracy of 0.00004 inch.

HARRINGTON ELECTRIC HOIST

A recent addition to the line of hoists manufactured by the Harrington Co., 17th and Callowhill Sts., Philadelphia, Pa., consists of the 1-ton electric hoist shown in the illustration. This hoist is driven by a universal motor which operates on direct or alternating current of 110 or 220 volts and of any frequency. The drive is through two pairs of spur gears and worm-gearing. Lubrication of all gears and main

Harrington Electric Hoist

bearings is accomplished automatically from a reservoir which need be refilled only a few times a year. The hoist may be supported by a hook, clevis, or trolleys of various designs, and changes from one type of suspension to another can be quickly made.

The ratio of the worm-gearing makes this mechanism self-locking, and so the load cannot overhaul the motor through the gearing. A brake on the motor shaft quickly stops the motor when the current is thrown off. This brake operates automatically when the hoist is started or stopped, and may be adjusted externally. Limit stops prevent over-travel of the hoist in either direction.

A fan mounted on the armature shaft draws air around the field windings and the armature to insure a cool motor at all times. A drum controller is provided for all rope-operated hoists, but an automatic controller, operated through a push-button, can also be furnished for remote control. The speed of hoisting ranges from 10 to 25 feet per minute, depending upon the load, while the lowering speed is always 25 feet per minute. Installation of the hoist is practicable in places of low head-room, as the distance from hook to hook is only 23 1/2 inches.

TAYLOR & FENN CONTOUR MILLING ATTACHMENT

Cams and other parts of irregular contour can be readily milled on the vertical milling machine built by the Taylor & Fenn Co., Hartford, Conn., by employing an attachment re-

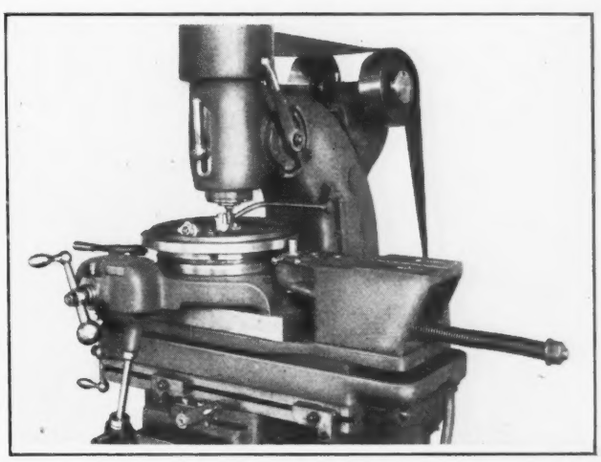


Fig. 1. Taylor & Fenn Contour Milling Attachment

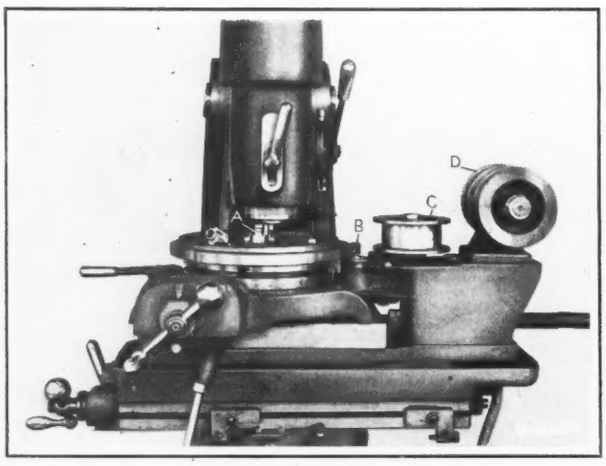


Fig. 2. Taylor & Fenn Contour Milling Attachment set up for producing the Former Plate

cently brought out by that company. As may be seen in Fig. 1, the attachment is fastened directly to the power-feed rotary table of the standard machine. The required shape is produced from a former plate fastened to the table and held against a roller through the action of an adjustable spring. As the table rotates, this former feeds the work toward and away from the cutter to suit the desired outline of the work. Speeds and feeds may be quickly varied to suit requirements.

For economically shaping the former, the same company builds a generating device by means of which the former is produced from a model or sample of the work. A guide pin of the same diameter as the cutter to be used is inserted in the spindle of the machine, as shown in Fig. 2, and the model A is held against this pin through pressure exerted by a spring. A milling cutter *B* of the proper size replaces the roller against which the former plate is to travel. This cutter is driven through gears and a belt running over pulleys *C* and *D*. When the table rotates, the entire fixture moves back and forth as the model revolves in contact with the guide pin in the spindle, with the result that the desired contour is milled in the former plate. Fig. 3 shows a variety of parts milled by this method.

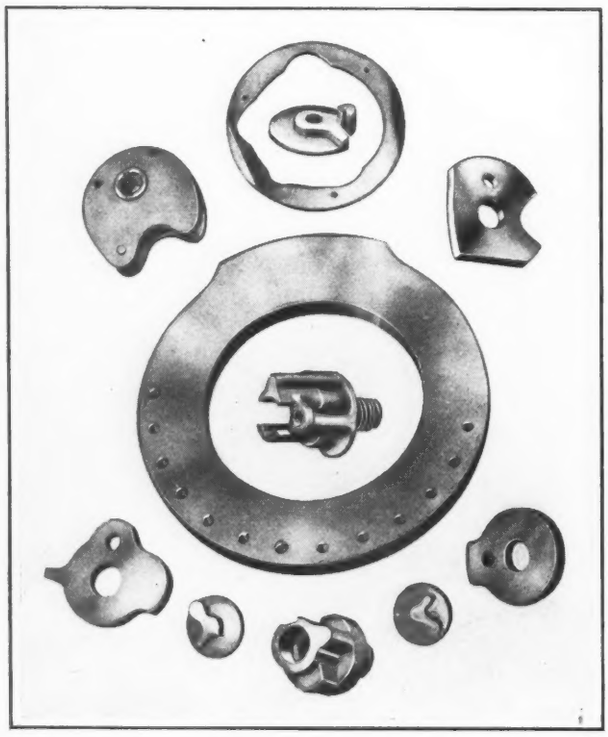
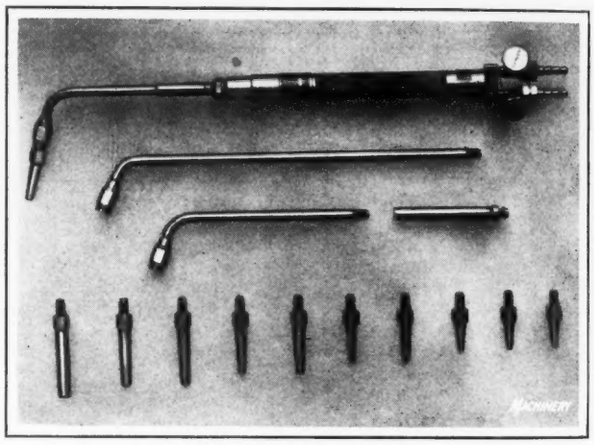


Fig. 3. Examples of Work milled on a Machine equipped with the Contour Milling Attachment

AIRCO-DAVIS-BOURNONVILLE WELDING TORCH

A style 7700 oxy-acetylene welding torch, which covers the full range of welding from sheet metal to heavy forgings and castings, is being placed on the market by the Air Reduction Sales Co., 342 Madison Ave., New York City. In all torches of previous design, with the exception of one, it was necessary to operate with a slight excess of oxygen, in order to lessen the liability of back-firing, the required excess oxygen varying widely with the design of the mixing head and the tip used on the torch. The ideal welding condition is to burn one volume of acetylene with one volume of oxygen supplied through the torch. Theoretically, 2 1/2 volumes of oxygen are required for the complete combustion of one volume of acetylene, 1 1/2 volumes of oxygen being taken from the air. When the new torch is used with oxygen of 99.5 per cent purity, a ratio of one volume of acetylene to 1.01 volume of oxygen is possible.

The new torch is shown in the accompanying illustration, together with extension tubes, mixing heads, and welding tips. The rear end of the torch is a brass forging provided with large gas passages. The handle is made of seamless knurled brass tubing, and is secured to the head and rear end by screws. The head is made of a special bronze, and



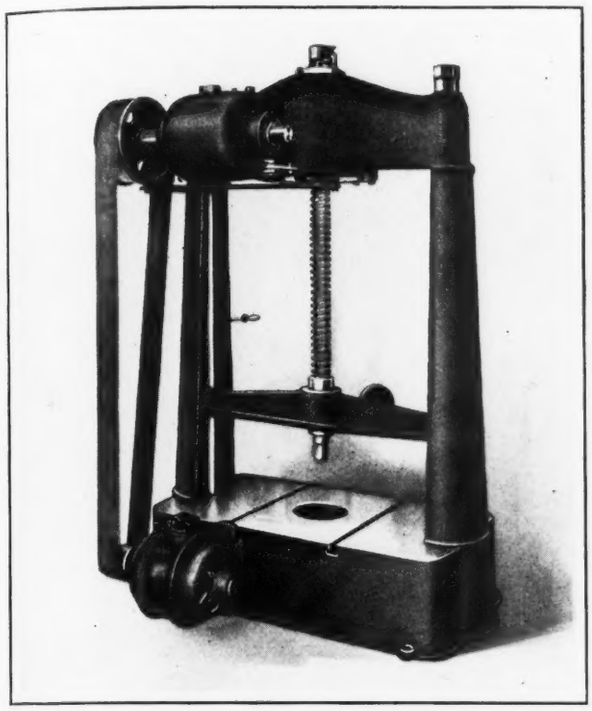
Airco-Davis-Bournonville Welding Torch with Extension Tubes, Mixing Heads, and Tips

the tip nut, of phosphor-bronze. The oxygen and acetylene tubes are of seamless drawn brass, and are silver soldered to the head and the rear end. Three extension tubes, 6, 9, and 16 inches long, respectively, fit either of the two mixing heads and may be used with any tip from the smallest to the largest. The weight of the torch, complete with the larger mixing head, the 9-inch extension tube, and the largest tip, is 30 ounces.

ATLAS POWER-DRIVEN PRESS

A No. 63 power-driven screw-operated press has recently been placed on the market by the Atlas Press Co., Kalamazoo, Mich. This press is controlled by means of a marine-type multiple-disk clutch, which is engaged through a lever located in front of the right-hand housing, viewing the machine from the front. The ram may be stopped at any point, and the clutch set to slip when the required tonnage is exceeded. The standard press is built for 50-ton work and with a ram travel of approximately 7 feet per minute. However, by furnishing a different driving worm, gear, and screw, the speed of the ram can be increased or decreased.

Special bases or fixtures may be supplied to suit requirements, and also uprights of any height. T-slots and keyways are provided in the standard base to permit of accurately fitting jigs and fixtures. A five-horsepower motor running at 1200 revolutions per minute is recommended by the builder for driving the press. Some of the principal specifications of this machine are as follows: Distance between housings, 37 inches; maximum distance between screw and

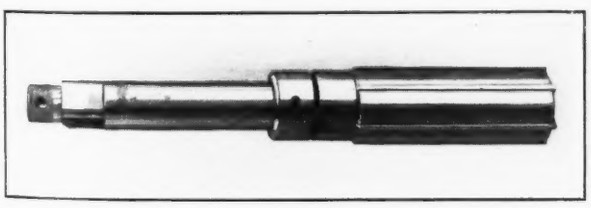


Atlas Screw-operated Press with Motor Drive

base, 37 inches; maximum movement of ram, 30 inches; height of machine over-all, 81 inches; and floor space required, 30 by 54 inches.

FOSTER-JOHNSON ADJUSTABLE HAND REAMERS

The important feature of a line of hand reamers being placed on the market by the Foster-Johnson Reamer Co., Elkhart, Ind., is that the blades may be expanded radially after being inserted full length into the work. Adjustment of the blades is effected through the medium of the knurled nut at the top end of the reamer. The bottom of this nut is graduated in thousandths of an inch to show the amount of expansion or contraction given to the blades. Removal of the reamer from the work is effected by contracting the blades and then drawing the reamer straight out.



Foster-Johnson Adjustable Hand Reamer

When the blades are expanded in the work, they are not forced into the metal, but are firmly seated against the walls until the tool is revolved. During the first quarter of a revolution, the blades feed outward to the full depth of the cut to which they have been adjusted by the knurled nut. The feed is accomplished through a spring collar. The reamers are manufactured in five sizes, from 1 3/8 to 4 3/4 inches, and the range of expansion varies from 1/8 inch on the smallest size to 1/4 inch on the largest size.

"WEAR-EVER" CHUCKS

A line of "Wear-Ever" quick-change chucks of the design illustrated is being introduced to the trade by Scully-Jones & Co., 13th and Robey Sts., Chicago, Ill. With one of these chucks, drilling, tapping, reaming, counterboring, and similar operations can be quickly performed in a single-spindle machine, because the tools can be interchanged without stopping the spindle or reducing its speed. To release a tool from one of the chucks, the knurled collar is gripped lightly, and the release is instantly obtained. In inserting a tool in a chuck, the collar is simply held until the tool collet is in place.

A control spring stops the collar in the correct position to release tools, and also insures an immediate engagement of the driving rollers with the quick-change collet when a tool is being inserted in a chuck. The chucks are regularly furnished with Morse taper or straight shanks, but they may also be made with special shanks. Collets of different styles can be provided. Five different sizes of chucks are made for Morse taper shanks from No. 1 to 6, inclusive.

TRENT MELTING POT

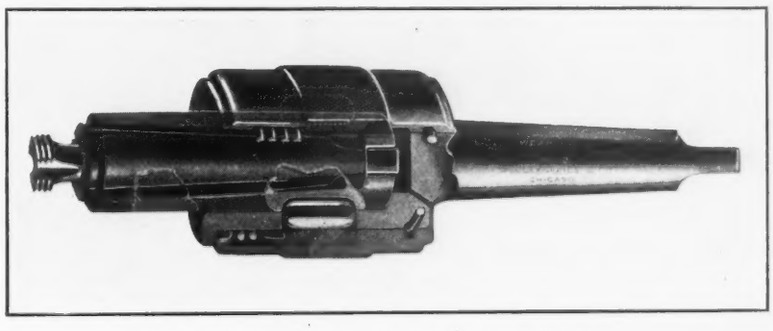
Two additions have been made to the line of electric melting pots manufactured by Harold E. Trent, 259-261 N. Lawrence St., Philadelphia, Pa. The new pots are of 10 and 20

Trent Electric Melting Pot

pounds capacity, respectively, and are quite similar in appearance to the 45-pound pot shown in June MACHINERY. They are suitable for melting babbitt, lead, solder, and tin, and are adapted to 110- and 220-volt alternating or direct current. Current can be obtained from a lamp socket. A new design of protected plug contacts is used, whereby a standard plug obtains the three-heat combination. Spouts and two handles can be provided to facilitate pouring the molten metal. The crucible is insulated.

COULTER AUTOMATIC DIAMOND BORING MACHINE

Both ends of automotive connecting-rods are bored at one setting in the two-spindle automatic machine here illustrated, which uses diamonds for tools. This machine is a recent



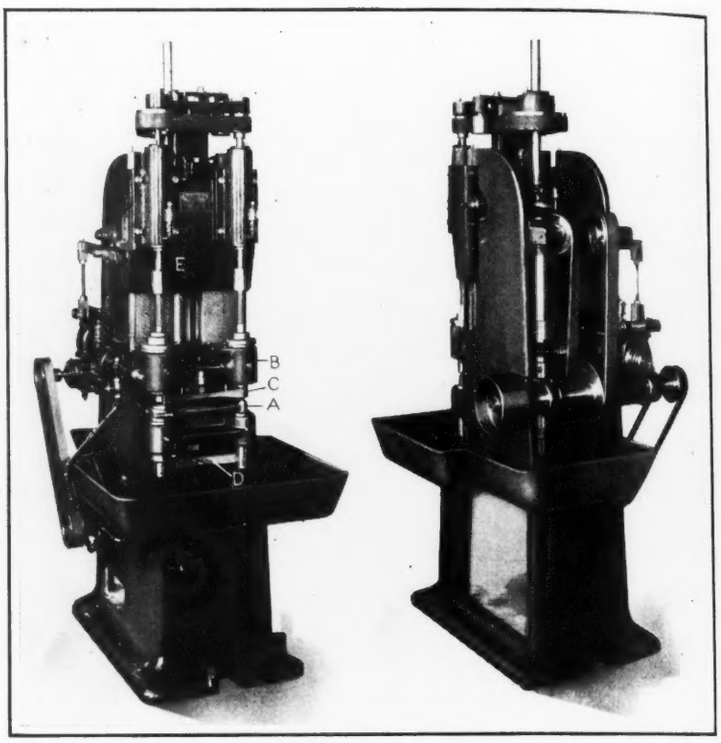
Construction of "Wear-Ever" Quick-change Chucks

development of the Automatic Machine Co., Bridgeport, Conn. For the operation, the connecting-rod is laid, as shown at *A*, on two lower bearings of the stationary casting *B*, which is bolted to the column of the machine. In these two lower bearings, are sliding non-rotating spindles, provided with plugs that project above the top of the bearings. These plugs fit the rough bores of the connecting-rod and thus locate it for the operation. The connecting-rod is clamped in place by means of bar *C*. Cross-bar *D* connects the two sliding work-locating spindles.

The two boring-bars are guided in the operation by the upper bearings of casting *B*. They are driven by the spindles of the sliding head *E* to which they are connected by means of special Oldham couplings. In addition to the bearings of casting *B*, the boring-bars are supported rigidly close to the cut by the lower end of each bar entering an axial hole in the corresponding work-locating plug.

The vertical movements of the spindle head, clamping bar *C*, and cross-bar *D* are controlled by cams on the vertical drum seen in the right-hand illustration. The cam for operating the spindle head is above the worm-gear, while the cams for the movements of the pilot plugs and clamping bar are below the worm-gear. As the feed of the spindle head is accomplished by gravity, the upper cam only controls the rate of movement during the downward stroke, but on the return stroke, the cam furnishes the power for returning the head to the upper position. The spindles approach the work rapidly to the point of starting the boring, and then slow down to a boring feed for the actual cutting.

Power for driving the machine is derived from a 3-horsepower motor in the base, which drives the horizontal back-shaft through pulleys. From this back-shaft, the cam-drum is driven through a worm-gear reduction unit. In the middle of the back-shaft there is a pulley which transmits power by belt over idler pulleys to a pulley on the vertical shaft located above the cam-drum. From a second pulley on this shaft, the power is delivered by belt to the upper ends of the two boring spindles. When the boring-bars have reached the end of their downward stroke, the drive to the spindles is automatically disengaged, so that the cutters do not revolve as they are withdrawn from the work. At the end of each cycle of operation, the machine stops automatically. The weight of this machine is approximately 3900 pounds.

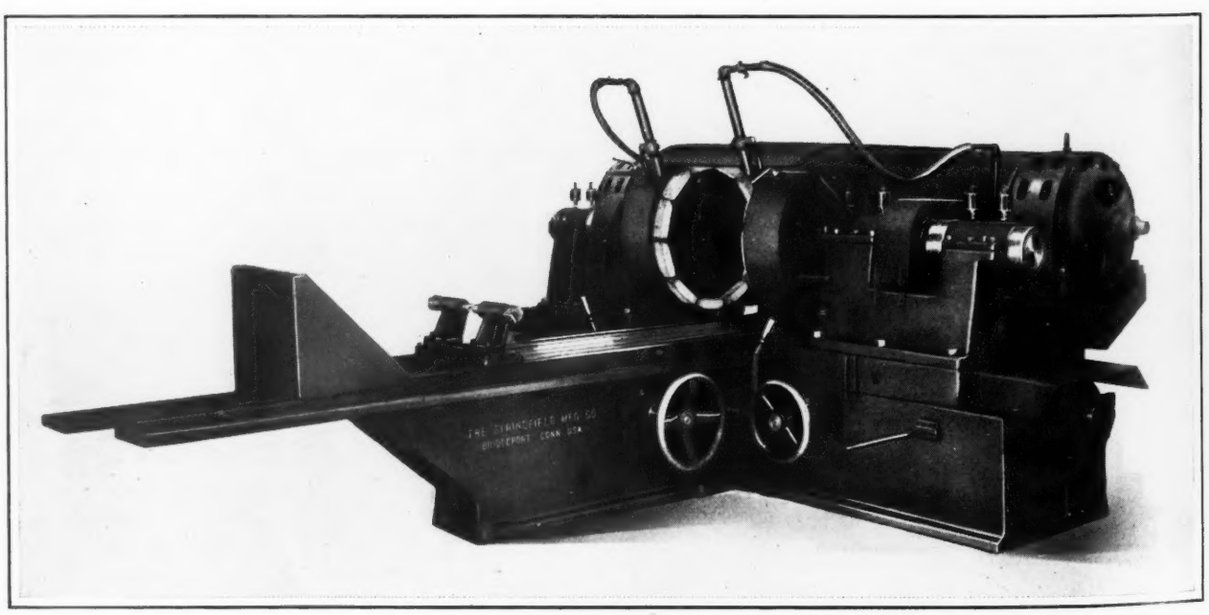


Coulter Connecting-rod Boring Machine in which Diamonds are used for Tools

SPRINGFIELD HEAVY-DUTY DOUBLE-HEAD FACE GRINDER

A heavy-duty, double-head face grinder, designed for simultaneously grinding two opposite sides of castings, has recently been built by the Springfield Mfg. Co., Bridgeport, Conn. The reciprocating table of this machine has a working surface 84 inches long, and grinds work up to 36 inches wide between the grinding wheels. Two 30-inch sectional chucks of new design are provided. These chucks are supported and driven by spindles 6 inches in diameter, which are equipped with large ball bearings for taking the thrust of the grinding wheels. The chucks receive the standard shapes of abrasive blocks made by the various grinding wheel manufacturers, and either silicate or vitrified blocks may be used.

Each chuck is built in two sections. The outer portion or ring which holds the abrasive segments is made from a steel



Springfield Heavy-duty Double-head Face Grinder

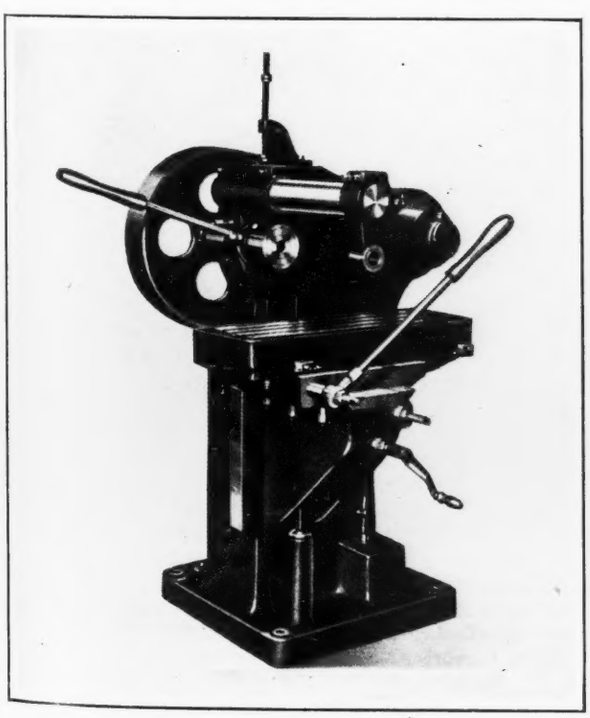
casting. This casting is bolted to a heavy spider, dish-shaped at the center and heavily braced, which forms the hub. The construction reduces any liability of spring and distortion in the chucks. The chuck jaws are of a floating type to compensate for warpage of the segments, and each jaw is provided with a screw-operated device for feeding the blocks forward as they become worn. A brace type of wrench is used to operate the feeding device, and by counting the number of turns given this wrench, the operator can adjust each block forward the same amount.

Each grinding wheel is driven by a 40-horsepower motor which is connected to the corresponding wheel-spindle by means of a silent chain. The wheel-heads are fed by large screws equipped with ball bearings. Large sight-feed oilers lubricate the bearings of the wheel-spindles. Complete control of the machine is afforded from either side, it being possible to operate the wheel-heads singly or together. The table drive is through the familiar rack and gear-train arrangement, a three-horsepower motor furnishing the power for driving the table and the water pump. The machine, complete with motors, weighs about 23,000 pounds.

KENT-OWENS HAND MILLING MACHINE

A No. 2 heavy-duty hand milling machine has just been placed on the market by the Kent-Owens Machine Co., Toledo, Ohio. This machine will accommodate larger work than the No. 1 machine, and it will handle a greater variety of work. One of the important features is that the spindle is mounted in adjustable taper roller bearings which permit of running the spindle up to 2000 revolutions per minute. This covers the high speeds desirable for small-diameter cutters and for milling brass, aluminum, and other soft materials. The spindle pulley is of the flywheel type, this design being adopted in order to absorb the shock of the cutter teeth striking the work and thus keep vibration and chatter at a minimum.

The working surface of the table is 28 inches long by 7 inches wide, and is provided with two 5/8-inch T-slots. The over-all length of the table is 32 inches, and the over-all width, 11 inches. Extra long hand-levers, which are adjustable in length, are conveniently located for feeding the head and the table. The head may be moved 6 1/2 inches vertically, and the table 4 1/4 inches longitudinally by means of these levers. The table can also be fed 22 inches longitudinally, and the cross-slide 7 inches transversely, by means of cranks. Graduated dials are provided on the cross-slide and for the elevating feeds, to permit rapid and accurate adjustment of the work relative to the cutters. The maximum distance from the spindle to the table is 17 1/2 inches.



Kent-Owens Heavy-duty Hand Milling Machine

The machine may be driven either direct by a motor or from a countershaft. A motor of from 3 to 5 horsepower capacity is recommended by the manufacturer. When driven from a lineshaft, a Hyatt roller-bearing countershaft is provided. A reservoir having a capacity for 4 gallons of cutting lubricant is cast in the base. This machine weighs about 2100 pounds.

* * *

NEW HAVEN MACHINE TOOL EXHIBITION

The technical program which will be presented in connection with the sixth annual machine tool exhibition at New Haven, Conn., to be held September 7 to 10, includes a number of papers of unusual interest to mechanical executives. There will be three technical sessions, on Wednesday, Thursday, and Friday, September 8, 9 and 10. At the first session, which will be presided over by Carl F. Dietz, president of the Bridgeport Brass Co., Bridgeport, Conn., General Ruggles, of the Ordnance Department of the United States Army, will read a paper on "Sane Specifications and Intelligent Inspection." F. H. Penny, of the General Electric Co., will read a paper on "Individual Motor Drive Units versus Group Drive for Machine Tools."

At the second session, C. R. Burt, vice-president and general manager of the Pratt & Whitney Co., Hartford, Conn., will preside. Harold S. Falk, vice-president and works manager of the Falk Corporation, Milwaukee, Wis., will read a paper on "The District Apprenticeship System."

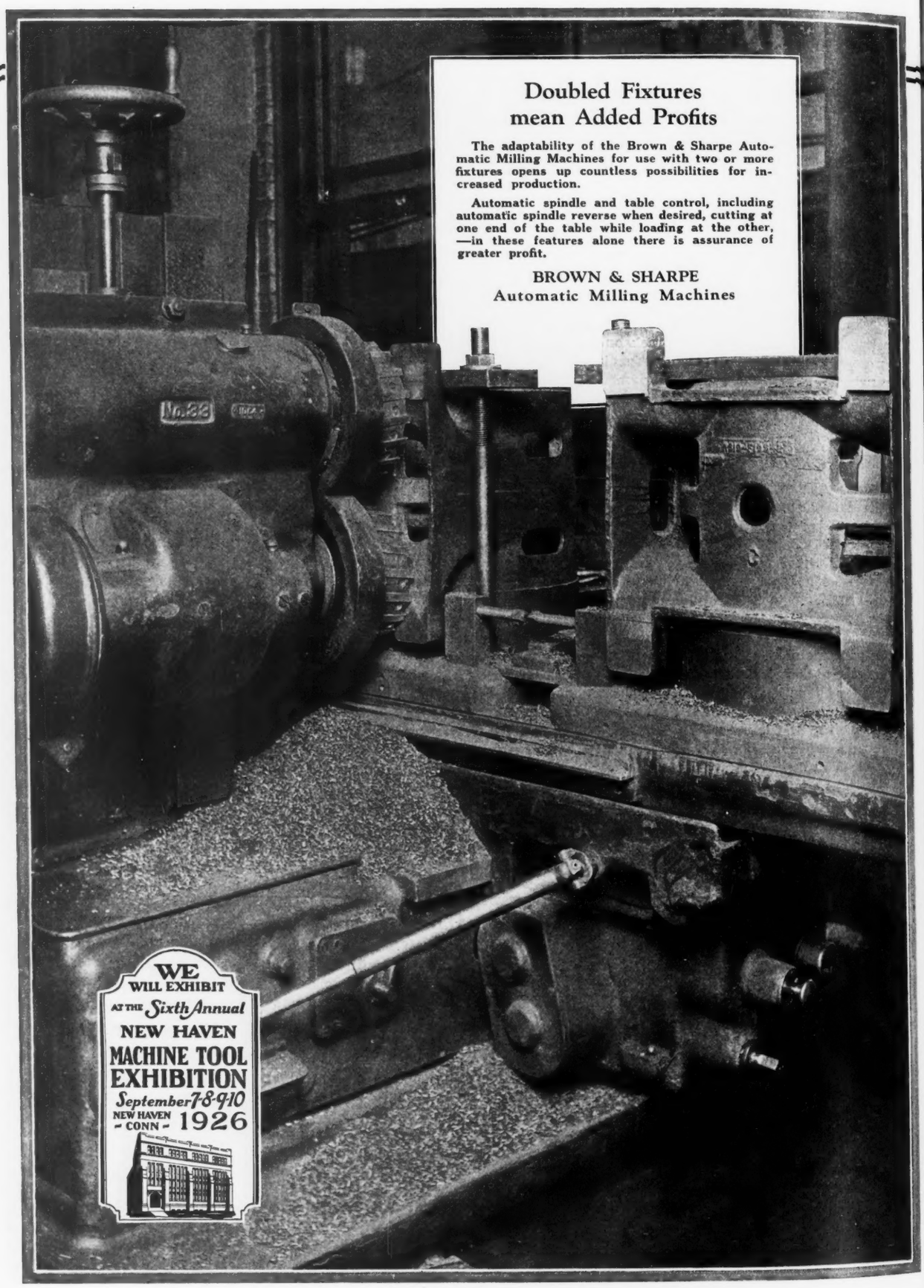
At the third session, W. F. Dixon, works manager of the Singer Mfg. Co., Elizabethport, N. J., and chairman of the Machine Shop Practice Division of the American Society of Mechanical Engineers, will preside. Two papers will be presented; the one entitled "The Coining Press in the Machine Shop—Some Hitherto Unrealized Values," has been prepared by E. V. Crane, of the E. W. Bliss Co., Brooklyn, N. Y. A progress report of the Gear Research Committee of the American Society of Mechanical Engineers will be presented by Earle Buckingham, professor of engineering standards, Massachusetts Institute of Technology, Cambridge, Mass.

* * *

AMERICAN FOUNDRYMEN'S CONVENTION

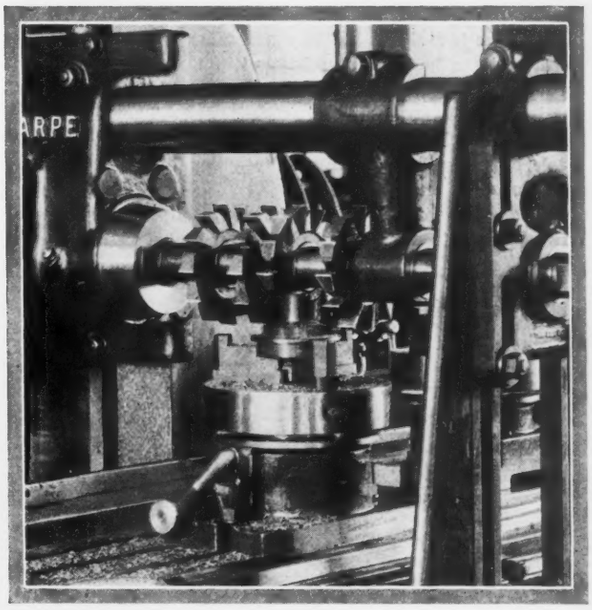
The thirtieth annual convention and exhibit of the American Foundrymen's Association and the second international foundrymen's congress will be held in Detroit, Mich., September 27 to October 1. The technical program in connection with the meeting will include papers on almost every phase of foundry practice and kindred work. At different sessions, the subjects that will be discussed in papers by well-known authorities cover non-ferrous metals, the handling of materials, cores and core binders, steel foundry practice, temperature determination, apprentice training, brass foundry topics, permanent and long-life molds, cupola practice, testing cast iron, malleable cast iron, casting nickel alloys, foundry costs, foundry refractories, foundry sand control, and elimination of waste in the foundry industry.

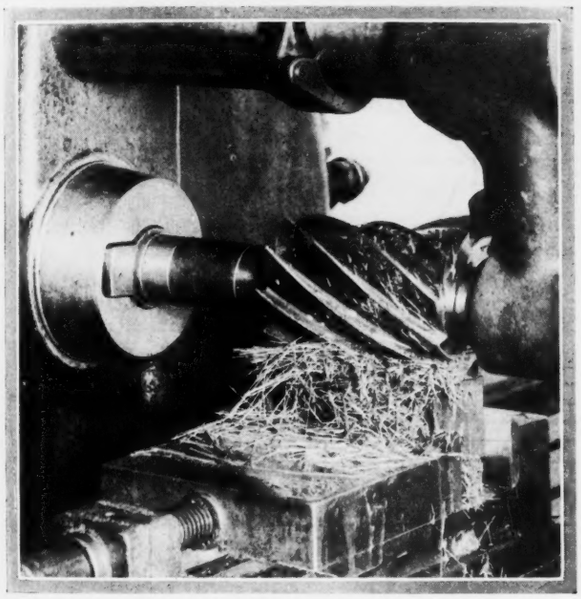
The exhibition will be held in the Coliseum and two other buildings of the Michigan State Fair Grounds at Detroit. The gross floor area of these three buildings is over 150,000 square feet, and the net exhibit space, exclusive of aisles, is 87,000 square feet. The concrete floors in two of the buildings and the dirt floor in the arena of the Coliseum, together with the unusual headroom in all the buildings, make possible the installation of all types of exhibits. More than 120 exhibitors have already reserved space. Among these are makers of all classes of foundry equipment, molding machinery, sand-treating machinery, core-making equipment and accessories, and equipment for cleaning castings. It is expected that this exhibit will include the most complete array of modern foundry equipment ever assembled in one place.


Doubled Fixtures
mean Added Profits
The adaptability of the Brown & Sharpe Automatic Milling Machines for use with two or more fixtures opens up countless possibilities for increased production.
Automatic spindle and table control, including automatic spindle reverse when desired, cutting at one end of the table while loading at the other, —in these features alone there is assurance of greater profit.
BROWN & SHARPE
Automatic Milling Machines
WE
WILL EXHIBIT
AT THE Sixth Annual
NEW HAVEN
MACHINE TOOL
EXHIBITION
September 7-8-9-10
NEW HAVEN
- CONN -
1926

"Automatic Milling Machines" is a booklet clearly illustrating the modern construction features of the machines and shows them at work on several representative jobs. Send for a copy.

It will profit you to use cutters that are tested for durability and "cutability"





Two jobs using Brown & Sharpe Coarse Tooth Cutters are shown. The modern design—the rugged teeth made to cut deeply without chatter—is evident.

But the pictures cannot show you the long record of steady service Brown & Sharpe Cutters make on such production work. Our representative will be glad to go over this point with you.

CUTTER designs developed by Brown & Sharpe are proved efficient by convincing tests.

Much useful information is gained and the performance of new designs accurately charted by trying out the cutters on an exhaustive variety of actual work in our own large plant.

Further, the data gained from a continual study of our customers' cutter problems is of great value in the development of new and improved designs.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

It will profit you to use cutters that are tested for durability and "cutability." Send for the new No. 30 Catalog. It lists the complete line of more than 1500 modern cutters.

TUMBLING BARREL

By F. C. MASON

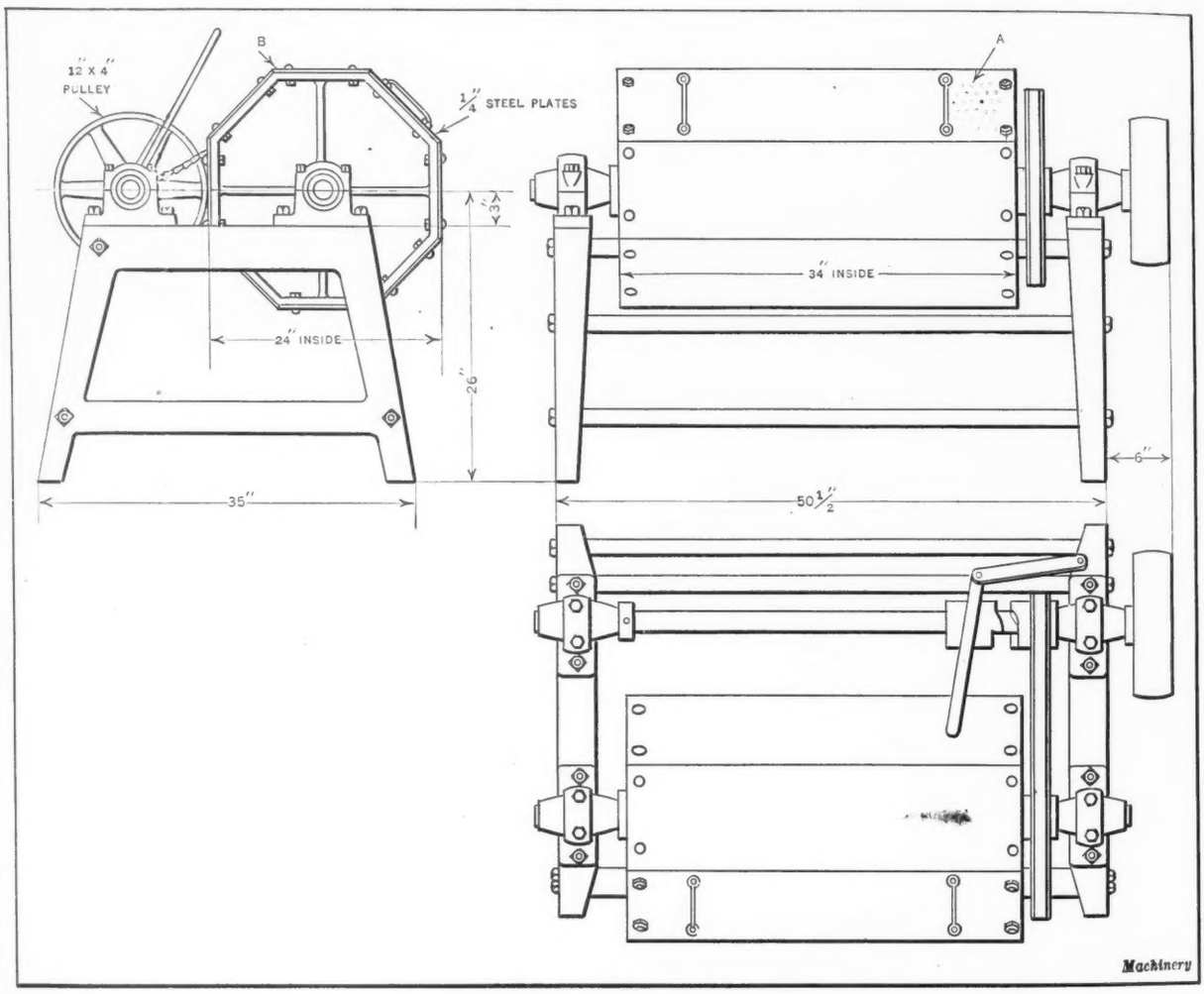
In the accompanying illustration, is shown a tumbling barrel that the writer believes has many advantages over the usual design. It is inexpensive to build, and for one particular purpose, at least, has been found exceptionally efficient. The individual clutch arrangement on the drive shaft permits it to be made up in multiple units with a single-pulley drive. It can also be made up in any length using castings made from the same patterns. Therefore, if patterns for the head and the leg castings are available, a tumbling barrel of almost any desired capacity can be readily made up.

Although the construction of the tumbling barrel is shown quite clearly in the illustration, it may be well to describe some of the details more fully. Generally, the most difficult problem in building a tumbling barrel is to make the trunnions run true. In the design shown, this can be easily accomplished.

The head castings can be clamped against the lathe face-plate for boring the trunnion holes. When putting on the side plates, or staves, which are made of mild sheet steel or iron, 1/4 inch thick by 8 inches wide and of the required length, a straight set-up shaft running the full length of the barrel is used to keep the head castings in perfect alignment. After the bolt holes are drilled in the plates, the plates are placed on the head castings and used as jigs for locating the bolt holes in the castings. Lock-washers, such as used in assembling automobiles, are placed under the bolt heads to prevent the bolts from working loose.

Most of the tumbling barrels on the market are either direct-driven or have a gear reduction for heavy loads. As cast gears are generally employed for the gear reduction, this type of drive is very noisy. On the tumbler shown in the illustration, a Link-Belt chain and sprocket drive is used. A standard two-jaw slip clutch is employed to engage and disengage the drive. The spherical pillow blocks make the trunnion bearings self-aligning. With stock parts, such as used in the tumbler described, it is possible to make up quickly, any number of tumbling barrels. The octagonal shape of the barrel and the drive used permit heavy loads to be handled rapidly.

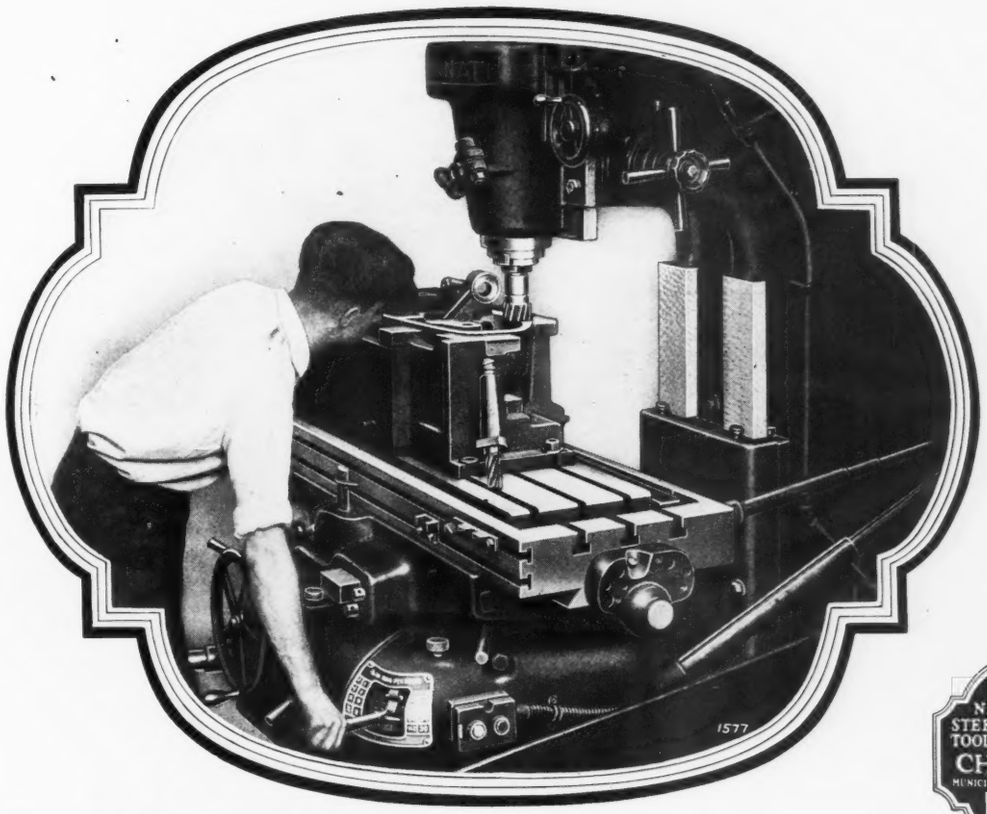
The work for which this tumbler is particularly adapted is the cleaning, with sawdust, of parts that are to be plated. When used for this purpose, all plate or stave joints are welded tight, except those of the door-plate. Perforations like those indicated at *A* in one end of the door-plate extend for the full length of the plate. These holes are 5/16 inch in diameter, and are spaced 3/4 inch apart, thus making the door serve as a sifting screen. The parts to be tumbled and the sawdust are loaded into the tumbling barrel until it is three-fourths full. The barrel is then set in motion, and within twenty or thirty minutes, the parts will be thoroughly cleaned.



Tumbling Barrel for cleaning Parts to be plated

* * *

Nine years is to be the minimum time in which the degree of "Engineer" may be obtained from Lehigh University. The usual four-year course will lead to the degree of Bachelor of Science. Five years of acceptable practical experience in responsible charge of work after graduation, and the submission of a suitable thesis, will be required before the university will stamp a candidate as a full-fledged civil, mechanical, electrical or chemical engineer. "Engineers cannot be trained by a purely academic process," explains the announcement of this innovation. It is predicted that this plan will be adopted by other technical colleges.



WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
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BOOTH NO. 217

CLICK!

—INTO THE RIGHT FEED

A *single* lever at the *front* of the knee by a *direct* movement gives any desired rate of feed.

It is so easy for the operator on Cincinnati No. 4 and No. 5 High Power Millers to shift this lever, that he is encouraged to select the *right* feed for the work—the feed at which the milling cutter will make the most profit for you.

Productive features like this make the Cincinnati Millers *real dividend payers.*

PROLONG PROSPERITY WITH MODERN MACHINE TOOLS

THE CINCINNATI MILLING MACHINE CO.

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CINCINNATI MILLERS

OBITUARIES

OBERLIN SMITH

Oberlin Smith, president and founder of the Ferracute Machine Co., Bridgeton, N. J., died at his home Monday, July 19, at the age of eighty-six years.

For fifty-two years Mr. Smith had been the active head of the Ferracute Machine Co., which he founded. He was born in Cincinnati, Ohio, March 22, 1840, and was educated at the West Jersey Academy at Bridgeton, N. J., and the Polytechnic Institute of Philadelphia, Pa., where he studied engineering. His first mechanical experience was obtained at the Cumberland Nail & Iron Works, and while there he invented a number of attachments and devices used in the production of this company. Later he worked in several Philadelphia shops, some of which were engaged in die work. A small shop on N. Laurel St. near Washington St., in Bridgeton, N. J., was Mr. Smith's first venture in business for himself. Here he made dies for canning machinery, and the developments of this business soon led to the founding of the Ferracute Machine Co., to which he devoted his life's efforts for more than half a century.

Mr. Smith was an ingenious mechanic and capable engineer, as well as executive. He obtained sixty patents on devices invented by him, many of which applied to the design of presses for cutting and forming metals, while others related to numerous other fields, including a system of gearing for turbines for ocean liners. He wrote numerous treatises on engineering subjects, and in 1906 published a book "Press Working of Metals," which had a wide sale.

Mr. Smith was a past-president of the American Society of Mechanical Engineers, a director of the Cumberland National Bank, and a member of the New Jersey Department of Conservation and Development. In addition, he was a member of numerous engineering societies, clubs, and civic organizations.

CHARLES A. COFFIN

Charles A. Coffin, founder and for thirty years head of the General Electric Co., Schenectady, N. Y., as president and chairman of the board of directors, died July 14 at his home in Locust Valley, L. I. Up to within the last two weeks Mr. Coffin had been going regularly to his office in New York.

He was born in December, 1844, in Somerset County, Me., and graduated from the Bloomfield (Me.) Academy. Showing a marked capacity for mercantile activity, he went to Boston as a young man and became interested in the shoe and leather industry, later forming the firm of Coffin & Clough at Lynn, Mass.

In 1883, Silas A. Barton, a Lynn printer and stationer, interested Mr. Coffin in the formation of a syndicate for the purchase of the American Electric Co. of New Britain, Conn., a small and struggling concern which was headed by Professor Elihu Thomson. The company was moved to Lynn in the latter part of 1883, and the name was changed to the Thomson-Houston Electric Co., Mr. Coffin becoming vice-president and treasurer. In 1892, occurred the consolidation of the Thomson-Houston Co. and the Edison General Electric Co. of New York, under the name of General Electric Co. Mr. Coffin was elected president of the new concern, and for the next twenty-one years directed its activities. He retired from the presidency of the company in 1913 and was made chairman of the board of directors, continuing to take an active part in the company's affairs until 1922.

TRADE NOTES

BURKE ELECTRIC CO., Erie, Pa., manufacturer of motors, generators and electric arc welding equipments, has appointed C. A. Cotton, 135 High St., Boston, Mass., district sales agent for the New England territory.

GRATON & KNIGHT CO., Worcester, Mass., was awarded the first prize in a competition of exhibits of sales campaign material at the convention of the Associated Advertising Clubs of the World recently held in Philadelphia.

CLEVELAND PLANER CO., 3148 Superior Ave., Cleveland, Ohio, has appointed the H. A. SMITH MACHINERY CO., Syracuse, N. Y., as exclusive representative for the sale of Cleveland open-side planers in the central New York territory.

KEARNEY & TRECKER CORPORATION, Milwaukee, Wis., has opened a new branch office in Philadelphia, Pa., with headquarters at Room 328, Witherspoon Bldg. F. G. Jackson, direct factory representative, will be in charge of this territory.

HENDEY MACHINE CO., Torrington, Conn., will take over the office of the W. M. Pattison Supply Co., 1534 Dime Bank Bldg., Detroit, Mich., on August 1. Edward B. Barker will continue in charge as branch manager for the Hendey Machine Co.

WILKIE MACHINE WORKS, Winona, Minn., manufacturer of precision garage machine tools, has expanded its business and changed the firm name to the CONTINENTAL MACHINE CO. The company is now located at 1301 Washington Ave., S., Minneapolis, Minn.

FARREL FOUNDRY & MACHINE CO., Ansonia, Conn., held its annual outing of the office and engineering department at Double Beach, Conn., on June 26. The features of the day were athletic events and a shore dinner, followed by brief addresses by the officials.

E. F. GRIFFITHS CO., manufacturer of gas and water meter parts, indicators, spring motors, screw machine products, sheet metal stampings, and radio parts, has removed its office from 1423 W. McFerran St., to 346 E. Walnut Lane, Philadelphia, Pa. The factory has been moved to 445 E. High St., Germantown, Philadelphia, Pa.

GEORGE M. BERNSTEIN & CO., 549 W. Washington Blvd., Chicago, Ill., has been established by George M. Bernstein, who was formerly connected with Louis E. Emerman & Co. of Chicago, machine tool dealers. The new company will deal in new and used machine tools, plate working and hydraulic equipment, and machinists' supplies.

PERCY M. BROTHERHOOD & SON, 25 Church St., New York City, announces that it is liquidating the plant of the Woodward & Powell Planer Co., Worcester, Mass., and is offering the buildings, land, power plant, equipment, patterns, drawings, and good will for sale. The real estate, equipment, patterns, and drawings will be sold separately if desired.

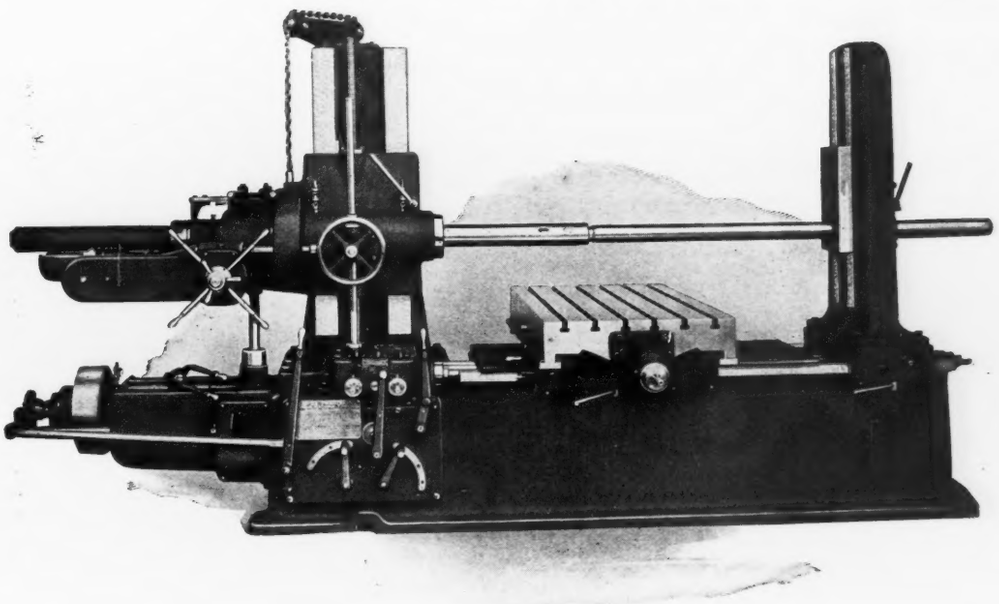
CHROMIUM CORPORATION OF AMERICA has been organized to take over the patents of the chromium plating process developed by the Chemical Treatment Co. and the Chromium Products Corporation, the latter a subsidiary of the Metal & Thermit Corporation. The new company will have plants and branch offices in most of the leading industrial centers.

MONITOR CONTROLLER CO., Baltimore, Md., manufacturer of automatic controllers and electrical resistors, has opened a branch office at 130 Federal St., Boston, Mass., (Room No. 417). Nelson A. McCoy, who has been located at the main office of the company for the last eight months, will be in charge of the new office. Mr. McCoy was previously associated with the Wagner Electric Corporation for fifteen years.

WILLIAM H. BARR has organized a brass foundry under his own name, for the production of brass and bronze castings, at 27 Carolina St., Buffalo, N. Y. Mr. Barr has been interested in the operation of brass foundries for about twenty-five years. John C. McCallum, a production engineer of wide experience, will serve as general superintendent. A foundry building having 20,000 square feet of floor space has been secured, and the moulding room is approximately 120 feet square.

PYROTUNG MFG. CO., 730 W. 50th St., Chicago, Ill., has just been organized to engage in commercial and special heat-treating of steels and in the manufacture of tools. The company will make use of a new method for hardening tools known as the "Pyrotung process." William R. Otis is president; Charles E. Sutten, vice-president; Charles E. Pynchon, general manager; B. C. Cleveland, head of staff of metallurgical engineers; and Charles T. Chance, superintendent of tests. Mr. Pynchon was formerly manager of the machinery and tool departments of Joseph T. Ryerson & Son, Inc.; Mr. Cleveland has specialized in heat-treatment research for many years; and Mr. Chance was formerly with the Colorado Fuel & Iron Co. at Pueblo, Colo., and has had a wide experience in the practical working and testing of steel.

We Have Other Thoughts Than Gross Sales



"PRECISION"

Horizontal Boring, Drilling and Milling Machine

and we have a theory (which so far has worked to our satisfaction) that the more thought we give to making the best machinery we know how, and finding ways to make it better, the less thought we NEED give to anything else.

WE ALSO MAKE THE

LUCAS POWER Forcing Press

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U. S. A.

FOREIGN AGENTS: Alfred Herbert Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague.

PERSONALS

B. A. BEHREND, consulting engineer, formerly at 85 Devonshire St., Boston, Mass., has removed his office and laboratory to 110 Cliff Road, Wellesley Hills, Mass.

RAYMOND FINK, formerly vice-president of the Pierce, Butler & Pierce Mfg. Corporation, New York City, has joined the executive staff of the Sherman Corporation, 31 Milk St., Boston, Mass., engineers.

WILLIAM J. BUTLER has become associated with the Bridgeport Brass Co., Bridgeport, Conn., manufacturer of flush valves, brass pipe, and tubular plumbing goods, as salesman. He will make his permanent residence in Boston.

L. F. KUHMAN has been appointed vice-president and director of the Andrews-Bradshaw Co., Pittsburg, Pa., sales managers for the Tracy steam purifier and Tracyfier gas and vapor scrubber. Mr. Kuhman was previously sales engineer for the Ingersoll-Rand Co. in the Pittsburg district.

ROBERT W. GILLISPIE, has been elected vice-president, assistant general manager, and a member of the board of directors of the Jeffrey Mfg. Co., Columbus, Ohio, manufacturer of coal mining machinery. Mr. Gillispie has been identified with the Bethlehem Steel Co. for many years, in charge of executive sales work.

JOSEPH O'NEILL, who has been connected with the Goodyear Tire & Rubber Co. for the last ten years, as department manager, has been appointed manager of advertising and sales promotion for the Imperial Electric Co., Akron, Ohio, manufacturer of alternating-current and direct-current motors and generators.

GEORGE E. GUSTAFSON, sales engineer for the Kearney & Trecker Corporation, Milwaukee, Wis., who has been looking after the interests of the company in the eastern territories of Boston and Philadelphia, will move to Detroit early in September, where he will make his headquarters with the Charles A. Strelinger Co.

I. D. PARKER, for seven years secretary of the Burke Machine Tool Co., Conneaut, Ohio, has resigned and is succeeded by H. ROCKWELL, for sixteen years superintendent and vice-president of the company. Mr. Rockwell will also serve as treasurer and general manager, and will handle matters of a sales and advertising nature.

D. W. MCGEORGE has been appointed sales engineer of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., manufacturer of hydraulic presses, rolling mill machinery, special machinery, steel castings, and rolling mill rolls. Mr. McGeorge was previously connected with the sales department of the Edgewater Steel Co., Pittsburg, Pa.

ERNEST WOOLER, chief engineer of the Timken Roller Bearing Co., Canton, Ohio, sailed on July 14 on the *Berengaria* for England. During his stay in England, Mr. Wooler plans to investigate the development of anti-friction bearings in all industries, including automotive, industrial, and transportation. He will visit the British Timken plant in Birmingham.

A. J. GERLACH, who has been assisting George L. Erwin, Jr., in looking after the advertising of the Kearney & Trecker Corporation, Milwaukee, Wis., has been promoted to the position of advertising manager, and JOSEPH TRECKER has been appointed assistant advertising manager. GEORGE L. ERWIN, JR., will continue to have supervision of the department, but will act chiefly in an advisory capacity.

B. M HORTER, formerly of the Philadelphia office of the Cutler-Hammer Mfg. Co., Milwaukee, Wis., has been appointed manager of the company's Boston office. He succeeds J. M. FERNALD who has resigned to enter a different field of business. Mr. Horter has been with the Cutler-Hammer Mfg. Co. since March, 1916, having started as office boy and been steadily advanced to his present position.

WALKER GILMER, who has been associated with the L. H. Gilmer Co., Philadelphia, Pa., for twenty years, has resigned his connection as chief of engineering, but will continue to act as a director of the company. While with the L. H. Gilmer Co., Mr. Gilmer has served in various capacities as factory manager, sales manager, and chief of engineering. He contemplates locating in Detroit, Mich., where he will do consulting and sales engineering and development work.

C. W. FISHER, who has been associated with the McMyler-Interstate Co., for the last two years in the sales engineering department at Cleveland, Ohio, has been made manager of the Chicago branch of the company. He will have charge of engineering and sales of steam shovels, gas shovels, locomotive cranes, clam-shell buckets, and other equipment made by the company, for the Upper Mississippi district, including Illinois, Indiana, Wisconsin, and parts of Minnesota and Nebraska.

WALTER A. WOOD has entered business as an industrial and purchasing engineer at 151 Fifth Ave., New York City. His work will embrace the designing and installing of factory and office equipment, appraising, auditing, cost-finding, and other engineering activities. He has previously been associated with several manufacturers and appraisers of industrial equipment, and for the last two years has been studying the application of various types of office equipment for the Metropolitan Life Insurance Co. Mr. Wood will also handle insurance and real estate. He will be glad to have manufacturers of industrial equipment and office equipment send their bulletins to him.

CHARLES V. ALLEN has been elected treasurer and assistant secretary of the Westinghouse Electric International Co., East Pittsburg, Pa., to fill the vacancies caused by the resignation of H. A. CARMICHAEL. Mr. Allen has been connected with the manufacturing and sales division of the Westinghouse Electric & Mfg. Co. and the Westinghouse Electric International Co. for more than thirty years. He entered the employ of the Westinghouse Co. in 1893, taking the graduate student course, which he completed in one year's time. His rise was steady and rapid until in 1921 he was made manager in Mexico, and held that position until 1925, when he was promoted to the position of assistant treasurer of the Westinghouse Electric International Co.

COMING EVENTS

JULY 1-SEPTEMBER 15—International Exhibition for Inland Navigation and Utilization of Hydraulic Power, at Basle, Switzerland. For further information apply to Organizing Secretary, International Exhibition, Basle V, Switzerland, or to the Swiss Federal Railroads, 241 Fifth Ave., New York City.

SEPTEMBER 1-3—Annual convention of the American Railway Tool Foremen's Association in Chicago, Ill.; headquarters, Hotel Sherman. G. G. Macina, secretary, 11402 Calumet Ave., Chicago. The annual exhibit of the American Railway Tool Foremen's Supply Association will be held in conjunction with this convention.

SEPTEMBER 2-3—Aeronautic meeting of the Society of Automotive Engineers at the Bellevue-Stratford Hotel, Philadelphia, Pa. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

SEPTEMBER 7-10—Machine tool exhibition in the Mason Laboratory, Sheffield Scientific School, Yale University, New Haven, Conn. H. R. Westcott, chairman, 400 Temple St., New Haven, Conn.

SEPTEMBER 20-24—Eighth annual convention and exposition of the American Society for Steel Treating to be held at the Municipal Pier, Chicago, Ill. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 21-23—Production meeting of the Society of Automotive Engineers to be held at the Hotel Sherman, Chicago, Ill., simultaneously with the exposition of machine tools and heat-treating equipment sponsored by the American Society for Steel Treating. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

SEPTEMBER 27-OCTOBER 2—Annual convention of the American Foundrymen's Association and second international foundry congress in Detroit, Mich. In conjunction with these conventions there will be held an international exposition of foundry and machine shop equipment and supplies. C. E. Hoyt, secretary-treasurer, 140 S. Dearborn St., Chicago, Ill.

OCTOBER 2-10—Southern exposition to be held in the New Madison Square Garden, Eighth Ave. and 49th St., New York City. W. G. Sirrine, president of the exposition, New Madison Square Garden, New York City.

NOVEMBER 16-18—Transportation and service meeting of the Society of Automotive Engineers at the Copley-Plaza Hotel, Boston, Mass. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 16-19—Eighth annual fall meeting of the American Welding Society in conjunction with the International Welding and Cutting Exposition, Inc., at the Broadway Auditorium, Buffalo, N. Y.

DECEMBER 6-11—Fifth national exposition of power and mechanical engineering at the Grand Central Palace, New York City. Managers of the exposition: Charles F. Roth and Fred W. Payne of the International Exposition Co., Grand Central Palace, New York City.

SOCIETIES, SCHOOLS AND COLLEGES

UNIVERSITY OF MISSOURI, School of Mines and Metallurgy, Rolla, Mo. Bulletin treating of electrical precipitation as applied to gas streams.

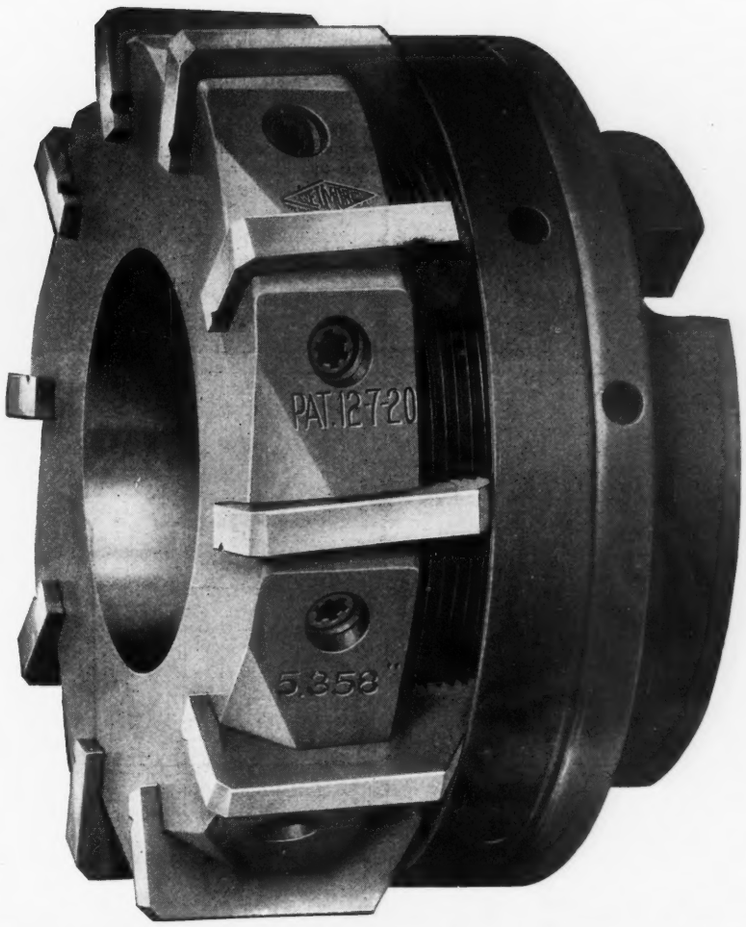
POLYTECHNIC INSTITUTE OF BROOKLYN, Brooklyn, N. Y. Catalogue of the College of Engineering for 1926-1927, containing outline of courses and general information.

TEMPLE UNIVERSITY, Broad St. and Montgomery Ave., Philadelphia, Pa. Annual catalogue (1926-1927) containing calendar, outline of courses, and other information relating to the university.

NEW BOOKS AND PAMPHLETS

ELIMINATION OF WASTE—GRINDING WHEELS. 23 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Simplified Practice Recommendation No. 45.

A distinctive feature of this Wetmore Shell Reamer is the ⅛" projection of the blades over the end of the reamer body for chip clearance. This allows the chips to fall off ahead of the reamer body and prevents chips from clogging up along cutting edge of blades.

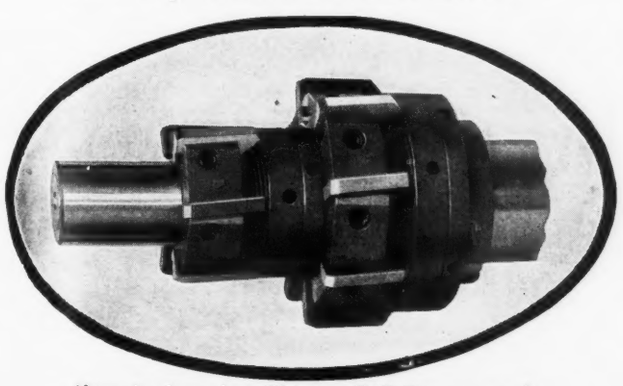


Wetmore Shell Reamers have .087" adjustment oversize. Made in these sizes: 1¼" to 3", 6 blades; 3-1/16" to 5", 8 blades; 5-1/16" to 6", 10 blades. Larger sizes made on order. Made also with straight hole, if desired. Sizes above 1¾" readily adaptable for line reaming.

Why Big Plants Specify WETMORE Shell Reamers

More than one user has told us that Wetmore Shell Reamers have done work they thought would be too much for any reamer.

But Wetmore Reamers have the habit of making good on hard jobs. We guarantee them to lower your production costs. They do faster work; they stand up longer; blade replacement costs are lower.



Above is shown how Wetmore Shell Reamers can be adapted for pilot reaming in combination or single.

Wetmore Shell Reamers are adaptable for either line or pilot reaming. Body, lock nut, and cone nut are finest alloy steel, heat-treated. Left-hand angle blades are staggered to eliminate chattering.

Send for Catalog No. 26

—showing the full line of Wetmore adjustable reamers, and reduced prices. Sent free—postpaid.

WETMORE REAMER CO.

60—27th St., Milwaukee, Wis.

WETMORE ADJUSTABLE REAMERS

"THE BETTER REAMER"

WIND PRESSURES ON STRUCTURES. By Hugh L. Dryden and George C. Hill. 36 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 523 of the Bureau of Standards. Price, 20 cents.

CAN WE COMPETE ABROAD? By C. C. Martin. 155 pages, 5¼ by 8 inches. Published by the National Foreign Trade Council, India House, Hanover Square, New York City. Price, paper bound, 25 cents.

This book contains a summary of the recent progress of American foreign trade, written in popular style.

PROBLEMS IN BLUEPRINT READING. By Drew W. Castle. 87 pages, 7¾ by 10¾ inches. Published by the Manual Arts Press, Peoria, Ill. Price, $1.44.

This little book has been written for the purpose of teaching the student how to read blueprints. The author believes that the reading of blueprints can be taught without first teaching drawing. The first part of the book is entitled "Information Topics," and takes up the three-view principle; sections; dimensions and notes; conventions and common mechanical terms; sketching; and instructions on how to work the blueprint reading problems. The second part of the book contains thirty problems which consist of a drawing with questions underneath to test the student's ability to read the drawing, and a blank sheet opposite on which the student is required to make freehand sketches in accordance with the data given in the problem.

CONTROLLERS FOR ELECTRIC MOTORS. By Henry D. James. 522 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $5.

The first edition of this book was published in 1919. Since then a part of the text has been rewritten, and considerable material has been added. The object of the book is to bring together in one volume sufficient material on control to give a good idea of its designs and operation for the use of students, operating engineers, purchasers, and users of electrical apparatus. The illustrations have been selected for the purpose of giving a good idea of the types of control in general use and to assist in understanding the text. Some elementary chapters have been included for the benefit of persons who have not had extensive experience with control apparatus. The material in this book should assist in understanding a controller, but must be supplemented by exact information covering the design under consideration.

BELT CONVEYORS AND BELT ELEVATORS. By Frederic V. Hetzel. 333 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $5, net.

The aim of this book is to give practical information on the design of belt conveyors and belt elevators. The information is based on knowledge gained by the author through thirty years of experience in designing, making, and selling machinery of this kind. An idea of the treatment will be obtained from the following list of chapter headings: General Description of Component Parts; Development of Belt Conveyors; Belts and Belt Manufacture; Supporting and Guiding the Belt; Driving the Belt; Tension and Take-up Devices; Loading the Belt; Discharging from the Belt; Protecting and Cleaning the Belt; Package Conveyors; Special Uses of Belt Conveyors; Life of Belts; When to Use Belt Conveyors; General Descriptions; Centrifugal Discharge Elevators; Elevator Buckets; Continuous Bucket Elevators; Belts for Elevators; Fastening Buckets to Belts; Driving Belt Elevators; Elevator Boots; Inclined Elevators; and Elevator Casings.

NEW CATALOGUES AND CIRCULARS

VENTILATING FANS. American Blower Co., Detroit, Mich. Bulletin 7003, illustrating and describing American H. S. fans for industrial use.

HEATING UNIT. General Electric Co., Schenectady, N. Y. Bulletin GEA-380, descriptive of the G.E. helicoil sheath wire unit —a newly developed form of heating unit.

RIVETED PIPE. American Spiral Pipe Works, Chicago, Ill. Circular containing an announcement of the fact that Taylor spiral riveted pipe is now made of copper-bearing steel.

VALVES. Bridgeport Brass Co., Bridgeport, Conn. Instruction and data book on Bridgeport-Keating flush valves, illustrating and describing the various models and giving installation instructions.

CENTRIFUGAL PUMPS. Barrett, Haentjens & Co., Hazelton, Pa. Bulletin 400a, entitled "Automatic Pumping," describing the automatic operation of centrifugal pumps, from a technical standpoint.

HAND CRANES. Herbert Morris, Inc., Buffalo, N. Y. Book 104, descriptive of Morris hand overhead cranes. A few of the standard types of Morris cranes are illustrated, and dimensions and capacities are given.

BORING MACHINES. Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating and describing special boring machines that have been built by this company to meet the requirements of special classes of work.

HEAT-TREATING APPARATUS. Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn. Bulletin 2607, entitled "The Mystery Taken out of Hardening," relating to the use of the Rockwell dilatometer in heat-treating.

SILENT GEAR MATERIAL. Fibroc Insulation Co., Valparaiso, Ind. Booklet entitled, "Silent Gears in Industry," descriptive of a new self-lubricating silent gear material, known as Fibroc "GR," on which this company has recently obtained patents.

CATERPILLAR TRACTORS. Caterpillar Tractor Co., San Leandro, Cal. Series of circulars descriptive of the Caterpillar tractor and its many applications, including snow removal, farming, road building, contracting, logging, hauling, dirt moving, etc.

ELECTRIC CONTROL EQUIPMENT. Cutler-Hammer Mfg. Co., 1266 St. Paul Ave., Milwaukee, Wis. Catalogue C-37, entitled, "Industry's Electrical Progress," illustrating various applications of the electric control equipment made by this concern.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Folder 38, illustrating and describing "Safety Arktite" plugs and receptacles, interlocking switches and plugs, and safety hand lamps. Bulletin 2087, containing data on type OCB condulet branch extensions.

AUTOMATICS. Cone Automatic Machine Co., Inc., Windsor, Vt. Catalogue illustrating and describing the complete line of Cone automatics which are made in sizes having capacities of ⅞, 1¼, 1½, and 1⅞ inches. Complete specifications of the machines are included.

SMALL TOOLS. Scully-Jones & Co., 13th and Robey Sts., Chicago, Ill. Catalogue 35, covering the complete line of "Wear-Ever" production tools for drilling, tapping, milling, and reaming operations, including chucks, milling cutters, extension sockets, sleeves, spacing collars, special tool-holders, and collets.

BLOWING AND VENTILATING SYSTEMS. Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio. Catalogue describing the Kirk & Blum blower systems, including collecting, ventilating, and conveying apparatus. The illustrations show a large number of installations in a variety of industries.

STEAM PURIFIER AND GAS AND VAPOR SCRUBBER. Andrews-Bradshaw Co., Pittsburg, Pa. Catalogue on the "Tracyfier" (Tracy steam purifier and gas and vapor scrubber), pointing out the necessity for cleaning steam and the benefits to be derived from the use of steam that is free from boiler water or dust.

BLUEPRINTING MACHINERY AND DRAFTING-ROOM SUPPLIES. C. F. Pease Co., 822 N. Franklin St., Chicago, Ill., is publishing a newspaper called "The Slogan News" containing much information on blueprinting. Those interested in this subject can obtain copies without charge upon application to the company.

ARC WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Catalogue GEA-423, entitled "Arc Welding in G-E Factories," showing the application of this process in manufacturing and miscellaneous processes; in tank manufacture; in making factory furniture and fixtures; in salvage and repairs; and structural steel work.

CRANES AND FOUNDRY EQUIPMENT. Whiting Corporation, Harvey, Ill. Catalogue 175, containing condensed data covering Whiting foundry equipment, including electric traveling cranes, cupolas, ladles, tumbling mills, core ovens, cars, trucks, turntables, overhead trolley systems, air hoists, elevators, annealing ovens, pneumatic grab buckets, etc.

TURRET LATHES. Warner & Swasey Co., Cleveland, Ohio. Catalogue descriptive of the new W & S No. 3-A turret lathe having a bar capacity of 7½ inches. The mechanical features of this machine are described in detail, as well as the standard tool equipment, and a typical example of the class of work for which this machine is adapted is shown.

ALUMINUM BUSES. Aluminum Co. of America, Pittsburg, Pa. Pamphlet entitled "A Revolution in Transportation," describing the evolution of means of transportation from the days of the stagecoach to the present automobile bus. The pamphlet also describes the use of aluminum in the manufacture of the new large-capacity automobile buses.

GRINDING MACHINES. Norton Co., Worcester, Mass. Book entitled "Two Norton Achievements," narrating the achievements of Aldus C. Higgins and Charles H. Norton, who were awarded the John Scott medal, respectively, for the electric furnace in which alundum is made commercially, and for the invention of accurate grinding devices of high power.

BUFFS. Bias Buff & Wheel Co., Inc., 342 Madison Ave., New York City. Handbook for buyers and users giving information with a view to enabling buyers of buffs to purchase equipment of this kind most economically. The booklet contains actual attached samples of materials used for buffs, together with instructions of value to buff buyers. Tables giving weights of disk buffs are also included.

REGULATORS FOR GENERATOR VOLTAGE CONTROL. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Pamphlet S. P. 1734, dealing with the problem of voltage regulation. This book is more in the nature of a treatise than a catalogue. It contains some information that has never before been published, including descriptions of the rheostatic type automatic voltage regulators, and special regulator applications.

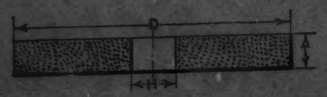
SPEED REDUCTION UNITS. Philadelphia Gear Works, Philadelphia, Pa. Catalog of speed reduction units, pointing out the advantages of speed reducers in general, and giving facts, figures, charts, and illustrations regarding the four types of units produced by this concern—namely, the spur gear type, worm-gear type, spiral-bevel and herringbone type, and straight herringbone gear type. A copy of the catalogue will be sent to those interested upon request.

MACHINE TOOLS FOR THE RAILWAY SHOP. Niles-Bement-Pond Co., 111 Broadway, New York City. Circular 325, describing the features of operation of the "Time-saver" planer—a powerful machine designed for high production. Circular 326, illustrating and describing the Niles 90-inch journal turning lathe —a high-production machine designed for the fast and accurate turning of locomotive journals. Circular 327, descriptive of the Niles 48-inch car-wheel borer. Circular 328, descriptive of the Niles 90-inch quartering machine for simultaneously boring crankpin holes in locomotive driving wheels.

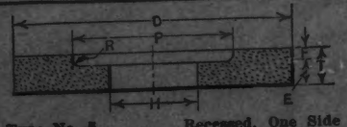
CUT OUT ON THIS LINE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

STANDARD WHEELS FOR INTERNAL GRINDING—2



Type No. 1 Straight



Type No. 5 Recessed, One Side

Type	D	T								H*	Recess	
											P	F
1	1 3/4	...	...	1/2	...	...	...	...		3/8	....	....
1	1 3/4	...	...	...	5/8	...	...	...		5/8	....	....
5	1 3/4	...	...	...	...	3/4	...	...		3/8	1	3/8
1	2	1/4	...	...	...	...	...	...		1/4	....	....
1	2	1/4	3/8	1/2	...	3/4	...	...		3/8	....	....
5	2	...	3/8	...	...	...	...	...		5/16	7/16	5/32
1	2	...	3/8	...	5/8	3/4	...	...		7/8	....	....
5	2	...	...	...	5/8	...	...	1		3/8	5/8	1/4
5	2	...	...	...	...	3/4	...	...		7/8	1 1/4	1/4
1	2 1/2	3/8	1/2	...	3/4	...	1	...		7/8	....	....
5	2 1/2	...	...	...	3/4	...	1	...		7/8	1 1/4	1/4
5	2 1/2	...	...	...	...	...	...	1 1/4		7/8	1 3/4	5/8
5	2 3/4	...	...	...	...	...	1	...		7/8	1 3/4	3/8
5	2 3/4	...	...	...	...	...	...	1 1/4		7/8	1 3/4	5/8
5	3	...	...	...	3/4	...	...	...		7/8	1 5/8	1/4
5	3	...	...	...	...	...	1	...		7/8	1 5/8	1/2
5	3	...	...	...	...	...	...	1 1/4		7/8	2 5/16	5/8
5	3 1/2	...	...	...	3/4	...	...	...		7/8	1 3/4	3/4
5	3 1/2	...	...	...	...	...	1	...		7/8	1 3/4	5/8
5	3 1/2	...	...	...	...	...	...	1 1/4		7/8	1 3/4	5/8
5	4	...	...	...	3/4	...	...	...		7/8	1 5/8	1/4

*Arbors are sizes now in use.

Internal Grinding Wheel Standards for New Installations

Wheel Diameter	Arbor	Wheel Diameter	Arbor	Wheel Diameter	Arbor	Wheel Diameter	Arbor
1/4	1/8	3/4	1/4	1 1/2	3/8	3	7/8
3/8	1/8	7/8	1/4	1 3/4	3/8	3 1/2	7/8
1/2	3/16	1	1/4	2	3/8	4	7/8
5/8	3/16	1	3/8	2	7/8	4	1 1/4
5/8	1/4	1 1/4	3/8	2 1/2	7/8	.....	.....

Thicknesses, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2

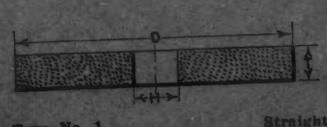
MACHINERY'S Data Sheet No. 66, New Series, September, 1925

CUT HERE

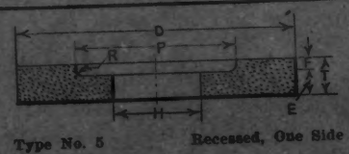
MACHINERY'S Data Sheet No. 65, New Series, September, 1925

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

STANDARD WHEELS FOR GRINDING—1



Type No. 1 Straight



Type No. 5 Recessed, One Side

Type	D	T								H*	Recess	
											P	F
1	1/4	1/4	...	...	...	...	...	...		1/8	....	....
1	3/8	1/4	3/8	...	...	...	...	...		1/8	....	....
5	3/8	1/4	...	...	...	...	...	...		1/8	1/4	5/32
1	7/16	1/4	...	...	...	...	...	...		3/16	....	....
1	7/16	...	3/8	...	...	...	...	...		1/8	....	....
5	1/2	1/4	...	...	...	...	...	...		1/8	1/4	5/32
1	1/2	1/4	...	...	...	...	...	...		1/4	....	....
1	1/2	1/4	...	1/2	...	...	...	...		3/16	....	....
1	9/16	...	3/8	1/2	...	...	...	...		3/16	....	....
5	5/8	1/4	...	...	...	...	...	...		1/8	1/4	5/32
1	5/8	1/4	3/8	1/2	5/8	...	...	...		3/16	....	....
1	5/8	1/4	3/8	...	...	...	...	...		1/4	....	....
1	11/16	...	...	1/2	5/8	...	...	...		3/16	....	....
1	3/4	1/4	3/8	1/2	5/8	3/4	...	...		1/4	....	....
5	3/4	...	3/8	...	...	...	...	...		1/4	7/16	5/32
5	7/8	1/4	...	...	...	...	...	...		1/8	1/4	5/32
1	7/8	1/4	3/8	1/2	...	...	...	...		1/4	....	....
5	7/8	...	3/8	...	...	...	...	...		1/4	7/16	5/32
5	7/8	...	3/8	...	...	...	...	...		5/16	7/16	5/32
5	1	1/4	...	...	...	...	...	...		1/8	1/4	5/32
1	1	1/4	3/8	1/2	5/8	3/4	...	...		1/4	....	....
1	1	1/4	3/8	1/2	5/8	3/4	...	...		3/8	....	....
5	1	...	3/8	...	...	...	...	...		1/4	7/16	5/32
5	1	...	3/8	...	...	...	...	...		5/16	7/16	5/32
5	1	...	...	...	5/8	3/4	...	...		3/8	5/8	1/4
5	1	...	...	...	...	...	...	...		3/8	....	....
1	1 1/4	1/4	3/8	1/2	...	3/4	7/8	1		1/4	7/16	5/32
5	1 1/4	...	3/8	...	...	...	...	...		5/16	7/16	5/32
5	1 1/4	...	3/8	...	...	...	...	...		3/8	5/8	1/4
5	1 1/4	...	...	...	5/8	...	...	...		1/4	7/16	5/32
5	1 1/2	...	3/8	...	...	...	...	...		5/16	7/16	5/32
5	1 1/2	...	3/8	...	...	...	...	...		3/8	....	....
1	1 1/2	...	3/8	1/2	5/8	3/4	...	...		3/8	5/8	1/4
5	1 1/2	...	...	...	5/8	...	...	1				

*Arbors are sizes now in use.

Approved by Grinding Wheel Manufacturers Association of the United States and Canada.

MACHINERY'S DATA SHEETS Nos. 65 and 66

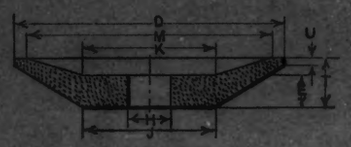
CUT OUT ON THIS LINE

CUT OUT ON THIS LINE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

STANDARD GRINDING WHEELS—4

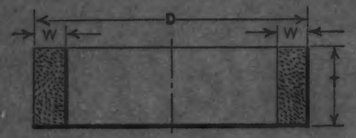
Dish Wheels



Type No. 12 — Dish

D	T	H	E	K and J	U	M
3	1/2	As ordered	5/16	1 1/2	1/16	2 3/4
3 1/2	1/2		5/16	1 3/4	3/32	3 1/8
4	1/2		5/16	2	3/32	3 5/8
4 1/2	1/2		5/16	2 1/4	1/8	4
5	1/2		5/16	2 1/2	1/8	4 1/2
6	1/2		5/16	3	1/8	5 1/4
6	3/4		3/8	3	1/8	5 1/4
8	3/4		1/2	4	1/8	7
8	1		1/2	4	1/8	7

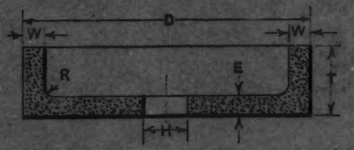
Cylinder Wheels



Type No. 2 — Cylinder

D	T	W
8	4	1
10	4	1
12	4	1 1/2
14	4	1 1/2
16	4	2
18	6	2
20	6	2 1/2
24	6	2 1/2
30	6	3

Straight Cup Wheels for General Use



Type No. 6 — Straight Cup

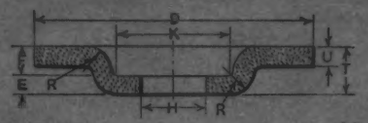
D	T	H	W	E
8	4	As ordered	1	1
10	4		1 1/4	1 1/4
12	4		1 1/2	1 1/2
14	4		1 1/2	1 1/2
16	5		2	2
20	6		2	2
24	6		2 1/2	2 1/2
30	8		2 1/2	2 1/2

Double Cup Wheels

Type No. 9 — Double Cup

D	T	H	W	E	A
4	2	As ordered	1/4	1/4	1/8

Offset Wheels



Type No. 14 — Offset

D	T	H	U	E	K	R
10	1	3	3/8	3/8	4	3/4
12	1 3/8	3	1/2	1/2	4 3/4	15/16

Approved by Grinding Wheel Manufacturers' Association of the United States and Canada.

MACHINERY'S Data Sheet No. 68, New Series, October, 1925

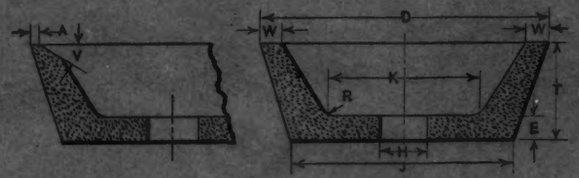
CUT HERE

MACHINERY'S Data Sheet No. 67, New Series, October, 1925

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

STANDARD GRINDING WHEELS—3

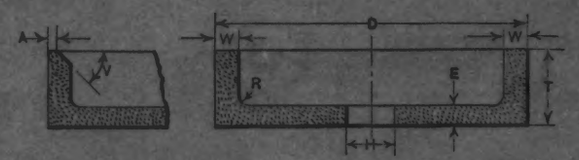
Flaring Cup Wheels



Type No. 11 — Flaring Cup

	Straight Face							Bevel Face	
D	T	H	W	E	J	K	R	A	V
3	1 1/4	As ordered	1/4	1/4	2 1/4	1 3/4	3/16	1/8	30°
3 1/4	1 1/4		1/4	1/4	2 1/8	1 1/2	3/16	1/8	30°
3 1/2	1 1/2		1/4	1/4	2 1/8	1 1/2	3/16	1/8	30°
4	1 1/2		1/4	1/2	3	2 5/8	3/16	1/8	30°
4 1/2	2		1/4	1/2	3 1/2	3	3/16	1/8	30°
5	1 3/4		1/4	3/8	3 1/2	3	3/16	1/8	30°
6	2		3/8	1/2	4 1/2	3 3/4	3/16	1/8	30°
7	2		3/4	1/2	5	3 3/4	3/16	...	...

Straight Cup Wheels for Tool Room Grinding



Type No. 6 — Straight Cup

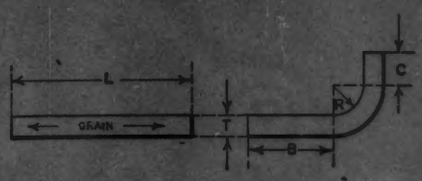
	Straight Face					Bevel Face	
D	T	H	W	E	R	A	V
2 1/2	1 1/2	As ordered	3/8	3/8	3/16	1/8	30°
3	1 1/2		3/8	3/8	3/16	1/8	30°
3 1/2	1 3/4		3/8	3/8	3/16	1/8	30°
4	1 1/2		3/8	3/8	3/16	1/8	30°
5	1 1/2		3/8	3/8	3/16	1/8	30°

Approved by Grinding Wheel Manufacturers' Association of the United States and Canada.

MACHINERY'S DATA SHEETS Nos. 67 and 68

MACHINERY'S DATA SHEETS Nos. 69 and 70

ALLOWANCES FOR 90-DEGREE BENDS IN SHEET METALS—1



$$\text{Allowance} = \left(\frac{T}{3} + R\right) \times 1.5708$$

This table is for 90-degree bends made in V-type dies and formed across the grain. To find length of flat blank, add to dimensions of straight sections, allowance Y at bend, for given radius and stock thickness T.

Example: Find length L of flat blank (see illustration) if $C = 1/2$ inch; $B = 3/4$ inch; $R = 3/16$ inch; and $T = 1/16$ inch.

Allowance Y in table = 0.3272 (see opposite 1/16 and under 3/16); hence $L = 1/2 + 3/4 + 0.3272 = 1.5772$ inches.

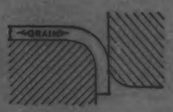
Thickness (T) of Stock, Inch	Inside Radius (R) of Bends, Inch										
	0	1/64	1/32	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32
	Allowance (Y) for Bends										
0.0102	0.0053	0.0299	0.0544	0.1035	0.1526	0.2017	0.2508	0.2999	0.3489	0.3980	0.4471
0.0141	0.0074	0.0319	0.0565	0.1055	0.1546	0.2037	0.2528	0.3002	0.3510	0.4001	0.4492
0.0188	0.0098	0.0344	0.0589	0.1080	0.1571	0.2062	0.2553	0.3044	0.3535	0.4025	0.4516
0.0250	0.0131	0.0376	0.0622	0.1113	0.1603	0.2094	0.2585	0.3076	0.3567	0.4058	0.4549
1/32	0.0164	0.0409	0.0654	0.1145	0.1636	0.2127	0.2618	0.3109	0.3600	0.4091	0.4581
0.0344	0.0180	0.0425	0.0671	0.1162	0.1653	0.2144	0.2634	0.3125	0.3616	0.4117	0.4598
0.0500	0.0262	0.0507	0.0753	0.1243	0.1734	0.2225	0.2716	0.3207	0.3698	0.4189	0.4680
1/16	0.0327	0.0573	0.0818	0.1309	0.1800	0.2291	0.2782	0.3272	0.3763	0.4254	0.4745
0.0650	0.0340	0.0586	0.0831	0.1322	0.1813	0.2304	0.2795	0.3286	0.3776	0.4267	0.4758
0.0703	0.0368	0.0613	0.0859	0.1350	0.1841	0.2331	0.2822	0.3313	0.3804	0.4295	0.4786
5/64	0.0409	0.0654	0.0900	0.1391	0.1882	0.2372	0.2863	0.3354	0.3845	0.4336	0.4827
0.0830	0.0434	0.0680	0.0925	0.1416	0.1907	0.2398	0.2889	0.3380	0.3871	0.4362	0.4852
3/32	0.0491	0.0736	0.0982	0.1473	0.1964	0.2454	0.2945	0.3436	0.3927	0.4418	0.4909
0.0950	0.0497	0.0743	0.0988	0.1479	0.1970	0.2461	0.2952	0.3443	0.3934	0.4424	0.4915
7/64	0.0572	0.0818	0.1063	0.1554	0.2045	0.2536	0.3027	0.3518	0.4009	0.4500	0.4990
1/8	0.0654	0.0900	0.1145	0.1636	0.2127	0.2618	0.3109	0.3600	0.4091	0.4581	0.5072
5/32	0.0818	0.1064	0.1309	0.1800	0.2291	0.2782	0.3273	0.3763	0.4254	0.4745	0.5212
3/16	0.0982	0.1227	0.1473	0.1964	0.2454	0.2945	0.3436	0.3927	0.4418	0.4909	0.5400

MACHINERY'S Data Sheet No. 69, New Series, November, 1925 Contributed by L. P. Vance

CUT HERE

ALLOWANCES FOR 90-DEGREE BENDS IN SHEET METALS—2

Allowances in this table are for stock drawn over edge of die and across grain. Allowance $= \left(\frac{T}{4} + R\right) \times 1.5708$



Thickness (T) of Stock, Inch	Inside Radius (R) of Bends, Inch										
	0	1/64	1/32	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32
	Allowance (Y) for Bends										
0.0102	0.004	0.0285	0.0531	0.1022	0.1512	0.2003	0.2494	0.2985	0.3476	0.3967	0.4458
0.0188	0.0074	0.0319	0.0564	0.1055	0.1546	0.2037	0.2528	0.3019	0.3510	0.4001	0.4491
0.0250	0.0098	0.0344	0.0589	0.108	0.1571	0.2062	0.2552	0.3043	0.3534	0.4025	0.4516
1/32	0.0123	0.0368	0.0613	0.1104	0.1595	0.2086	0.2577	0.3068	0.3559	0.405	0.4540
0.0344	0.0135	0.0380	0.0626	0.1117	0.1607	0.2098	0.2589	0.3080	0.3571	0.4062	0.4553
0.0500	0.0196	0.0442	0.0687	0.1178	0.1669	0.2160	0.2651	0.3142	0.3632	0.4123	0.4614
1/16	0.0245	0.0491	0.0736	0.1227	0.1718	0.2209	0.2700	0.3191	0.3681	0.4172	0.4663
0.0703	0.0276	0.0521	0.0767	0.1258	0.1749	0.2239	0.2730	0.3221	0.3712	0.4203	0.4694
5/64	0.0307	0.0552	0.0798	0.1288	0.1779	0.2270	0.2761	0.3252	0.3743	0.4234	0.4725
3/32	0.0368	0.0613	0.0859	0.135	0.1841	0.2332	0.2822	0.3313	0.3804	0.4295	0.4786
7/64	0.0429	0.0675	0.0920	0.1411	0.1902	0.2393	0.2884	0.3375	0.3866	0.4356	0.4847
1/8	0.0491	0.0736	0.0982	0.1473	0.1963	0.2454	0.2945	0.3436	0.3927	0.4418	0.4909
0.1406	0.0552	0.0798	0.1043	0.1534	0.2025	0.2516	0.3007	0.3497	0.3988	0.4479	0.4970
5/32	0.0613	0.0859	0.1104	0.1595	0.2086	0.2577	0.3068	0.3559	0.405	0.4540	0.5031
3/16	0.0736	0.0982	0.1227	0.1718	0.2209	0.2700	0.3191	0.3681	0.4172	0.4663	0.5154
0.2031	0.0798	0.1043	0.1288	0.1779	0.2270	0.2761	0.3252	0.3743	0.4234	0.4725	0.5215
0.2188	0.0859	0.1104	0.135	0.1841	0.2332	0.2822	0.3313	0.3804	0.4295	0.4786	0.5277
0.2344	0.0920	0.1166	0.1411	0.1902	0.2393	0.2884	0.3375	0.3866	0.4356	0.4847	0.5338
0.2500	0.0982	0.1227	0.1473	0.1963	0.2454	0.2945	0.3436	0.3927	0.4418	0.4909	0.5400
0.2656	0.1043	0.1288	0.1543	0.2025	0.2516	0.3007	0.3497	0.3988	0.4479	0.4970	0.5461
0.2813	0.1104	0.1350	0.1595	0.2086	0.2577	0.3068	0.3559	0.405	0.4540	0.5031	0.5522
0.3125	0.1227	0.1473	0.1718	0.2209	0.2700	0.3191	0.3681	0.4172	0.4663	0.5154	0.5645

MACHINERY'S Data Sheet No. 70, New Series, November, 1925 Contributed by L. P. Vance

Contributed by D. L. Flanagan

PUNCH ○ Punch holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

CUT OUT ON THIS LINE

PUNCH ○ Punch holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

CUT OUT ON THIS LINE

CUT OUT ON THIS LINE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

JIG AND FIXTURE CLAMP SIZES—2

Length of Unsupported Span of Clamp, Inches	Bolt Diameters, Inches				
	9/16	5/8	3/4	7/8	1
	Thicknesses and Widths of Clamps, Inches				
1	3/8 by 1 3/8 7/16 by 1 1/4	7/16 by 1 1/4	1/2 by 1 1/2		
1 1/4	7/16 by 1 3/8 1/2 by 1	7/16 by 1 1/2 1/2 by 1 1/4	1/2 by 1 3/4	5/8 by 1 1/2	
1 1/2	7/16 by 1 3/4 1/2 by 1 1/4	7/16 by 1 3/4 1/2 by 1 1/2	1/2 by 2 9/16 by 1 3/4	5/8 by 1 3/4	
1 3/4	7/16 by 2 1/2 by 1 1/2	7/16 by 2 1/4 1/2 by 1 7/8 9/16 by 1 1/2	1/2 by 2 1/2 9/16 by 2	5/8 by 2 1/4	3/4 by 2
2	7/16 by 2 1/4 1/2 by 1 3/4 9/16 by 1 1/2	7/16 by 2 3/4 1/2 by 2 1/4 9/16 by 1 3/4	9/16 by 2 1/4 5/8 by 2 3/4 by 1 1/2	5/8 by 2 1/2 3/4 by 1 3/4	3/4 by 2 1/4
2 1/4	1/2 by 2 9/16 by 1 3/4 5/8 by 1 1/4	1/2 by 2 1/2 9/16 by 2 5/8 by 1 3/4	9/16 by 2 1/2 5/8 by 2 1/4 3/4 by 1 3/4	5/8 by 3 3/4 by 2 1/4	3/4 by 2 1/2 7/8 by 2
2 1/2	1/2 by 2 1/4 9/16 by 2 5/8 by 1 1/2	1/2 by 2 3/4 9/16 by 2 1/4 5/8 by 2	9/16 by 3 5/8 by 2 1/2 3/4 by 2	3/4 by 2 1/2 7/8 by 2	3/4 by 3 7/8 by 2 1/4
2 3/4	1/2 by 2 3/4 9/16 by 2 1/4 5/8 by 1 3/4	1/2 by 3 1/4 5/8 by 2 1/4 3/4 by 1 5/8	5/8 by 2 3/4 3/4 by 2 1/8 7/8 by 1 3/4	3/4 by 2 3/4 7/8 by 2 1/4	7/8 by 2 1/2 1 by 2
3	1/2 by 3 9/16 by 2 1/2 5/8 by 2	9/16 by 2 3/4 5/8 by 2 1/2 3/4 by 1 3/4	5/8 by 3 3/4 by 2 1/4 7/8 by 2	3/4 by 3 7/8 by 2 1/2	7/8 by 2 3/4 1 by 2 1/4
3 1/2	9/16 by 3 1/2 5/8 by 2 1/2 3/4 by 1 3/4	9/16 by 3 1/2 5/8 by 3 3/4 by 2	5/8 by 4 3/4 by 2 3/4 7/8 by 2 1/4	3/4 by 3 3/4 7/8 by 3 1 by 2 1/4	7/8 by 3 1/2 1 by 2 3/4 1 1/8 by 2 1/4
4	5/8 by 3 3/4 by 2 7/8 by 1 1/2	5/8 by 3 1/2 3/4 by 2 1/2 7/8 by 2	3/4 by 3 1/4 7/8 by 2 1/2 1 by 2	7/8 by 3 1/2 1 by 2 3/4 1 1/8 by 2 1/4	7/8 by 4 1/4 1 by 3 1/4 1 1/8 by 2 3/4
5	5/8 by 4 3/4 by 2 3/4 7/8 by 2	3/4 by 3 7/8 by 2 1/4 1 by 2	3/4 by 4 1/4 7/8 by 3 1 by 2 1/2	7/8 by 4 1/4 1 by 3 1/4 1 1/8 by 2 3/4	7/8 by 5 1/4 1 by 4 1 1/8 by 3 1/4
6	3/4 by 3 1/2 7/8 by 2 1/2 1 by 2	3/4 by 4 1/4 7/8 by 3 1 by 2 1/4	7/8 by 4 1/4 1 by 3 1/8 1 1/8 by 2 1/2	1 by 4 1/4 1 1/8 by 3 1/2 1 1/4 by 2 3/4	1 by 5 1 1/8 by 4 1 1/4 by 3 1/4
8	3/4 by 5 1/4 7/8 by 3 1/4 1 by 2 3/4	7/8 by 4 1/2 1 by 3 1/4 1 1/8 by 2 1/2	1 by 4 3/4 1 1/8 by 3 3/4 1 1/4 by 2 3/4	1 1/8 by 5 1 1/4 by 4 1 3/8 by 3 1/4	1 1/4 by 5 1 3/8 by 3 3/4 1 1/2 by 3 1/4
10	7/8 by 5 1/2 1 by 3 3/4 1 1/8 by 3	1 by 4 3/4 1 1/8 by 3 1/2 1 1/4 by 3	1 1/8 by 5 1 1/4 by 4 1 3/8 by 3 1/4	1 1/8 by 7 1 3/8 by 4 1/2	1 3/8 by 4 1/4 1 1/2 by 4 1/2 1 3/4 by 3 1/2

MACHINERY'S Data Sheet No. 72, New Series, December, 1925 Contributed by P. De Greve

CUT HERE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

JIG AND FIXTURE CLAMP SIZES—1

Length of Unsupported Span of Clamp, Inches	Bolt Diameters, Inches				
	1/4	5/16	3/8	7/16	1/2
	Thicknesses and Widths of Clamps, Inches				
1	3/16 by 1 1/4	1/4 by 1	1/4 by 1 1/2 5/16 by 1	5/16 by 1 1/4 3/8 by 1 1/8	3/8 by 1 1/4 7/16 by 1 1/8
1 1/4	1/4 by 1	1/4 by 1 3/8	1/4 by 1 7/8 5/16 by 1 1/4	5/16 by 1 1/2 3/8 by 1 3/8	3/8 by 1 1/2 7/16 by 1 1/4
1 1/2	1/4 by 1 1/4	1/4 by 1 3/4 5/16 by 1 1/4	5/16 by 1 1/2 3/8 by 1 1/4	6/16 by 2 3/8 by 1 1/2 7/16 by 1 1/4	3/8 by 1 3/4 7/16 by 1 3/8 1/2 by 1 1/4
1 3/4	1/4 by 1 1/2 5/16 by 1	5/16 by 1 1/2 3/8 by 1	5/16 by 1 7/8 3/8 by 1 1/2	3/8 by 1 3/4 7/16 by 1 3/8 1/2 by 1 1/8	3/8 by 2 1/8 7/16 by 1 5/8 1/2 by 1 3/8
2	1/4 by 1 5/8 5/16 by 1 1/8	5/16 by 1 7/8 3/8 by 1 1/4	3/8 by 1 3/4 7/16 by 1 1/4 1/2 by 1 1/8	3/8 by 2 7/16 by 1 1/2 1/2 by 1 1/4	3/8 by 2 1/2 7/16 by 1 7/8 1/2 by 1 1/2
2 1/4	5/16 by 1 1/4 3/8 by 1	5/16 by 2 1/8 3/8 by 1 1/2	3/8 by 2 7/16 by 1 3/8 1/2 by 1 1/4	3/8 by 2 3/8 7/16 by 1 3/4 1/2 by 1 1/2	7/16 by 2 1/4 1/2 by 1 3/4 9/16 by 1 3/8
2 1/2	5/16 by 1 1/2 3/8 by 1 1/8	3/8 by 1 5/8 7/16 by 1 1/4	3/8 by 2 1/4 7/16 by 1 5/8 1/2 by 1 3/8	3/8 by 2 3/4 7/16 by 2 9/16 by 1 1/4	7/16 by 2 1/2 1/2 by 2 9/16 by 1 1/2
2 3/4	5/16 by 1 3/4 3/8 by 1 1/4	3/8 by 1 3/4 7/16 by 1 3/8	3/8 by 2 5/8 7/16 by 1 3/4 1/2 by 1 5/8	7/16 by 2 1/4 1/2 by 1 3/4 9/16 by 1 3/8	7/16 by 2 3/4 1/2 by 2 1/4 9/16 by 1 3/4
3	3/8 by 1 3/8 7/16 by 1	3/8 by 2 7/16 by 1 5/8	7/16 by 2 1/2 by 1 3/4 9/16 by 1 1/4	7/16 by 2 1/2 1/2 by 2 9/16 by 1 1/2	7/16 by 3 1/4 1/2 by 2 1/2 9/16 by 2
3 1/2	3/8 by 1 5/8 7/16 by 1 3/8	3/8 by 2 1/2 7/16 by 1 7/8 1/2 by 1 1/2	7/16 by 2 1/2 1/2 by 2 9/16 by 1 1/2	1/2 by 2 1/2 9/16 by 2 5/8 by 1 5/8	1/2 by 3 9/16 by 2 1/2 5/8 by 2
4	3/8 by 2 7/16 by 1 5/8	7/16 by 2 1/4 1/2 by 1 7/8	1/2 by 2 1/4 9/16 by 1 3/4 5/8 by 1 1/2	1/2 by 3 1/8 9/16 by 2 3/8 5/8 by 2	9/16 by 3 5/8 by 2 1/2 3/4 by 1 5/8
5	3/8 by 2 3/4 7/16 by 2 1/2 by 1 1/2	7/16 by 2 3/4 1/2 by 2 1/4 9/16 by 1 3/4	9/16 by 2 1/2 5/8 by 2 3/4 by 1 3/8	9/16 by 3 5/8 by 2 1/2 3/4 by 1 3/4	9/16 by 4 5/8 by 3 3/4 by 2
6	7/16 by 2 1/2 1/2 by 2 9/16 by 1 1/2	1/2 by 2 5/8 9/16 by 2 1/4 5/8 by 1 7/8	9/16 by 3 1/4 5/8 by 2 1/2 3/4 by 1 3/4	5/8 by 3 1/4 3/4 by 2 1/4 7/8 by 1 3/4	5/8 by 4 3/4 by 2 3/4 7/8 by 2
8	1/2 by 3 9/16 by 2 1/4 5/8 by 1 7/8	9/16 by 3 1/2 5/8 by 2 3/4 3/4 by 1 7/8	5/8 by 4 3/4 by 2 1/2 7/8 by 2	3/4 by 3 1/4 7/8 by 2 1/4 1 by 2	3/4 by 4 1/4 7/8 by 3 1 by 2 1/4
10	9/16 by 3 1/4 5/8 by 2 3/8 3/4 by 1 3/4	5/8 by 4 3/4 by 2 5/8 7/8 by 1 7/8	3/4 by 3 3/4 7/8 by 2 3/4 1 by 2	3/4 by 4 3/4 7/8 by 3 1/4 1 by 2 1/2	7/8 by 4 1/4 1 by 3 1 1/8 by 2 1/4

MACHINERY'S Data Sheet No. 71, New Series, December, 1925 Contributed by P. De Greve

MACHINERY'S DATA SHEETS Nos. 71 and 7

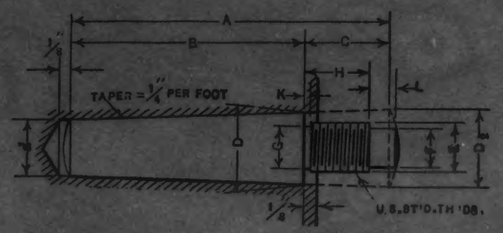
CUT OUT OR THIS LINE

CUT OUT ON THIS LINE

PUNCH ○ ○ PUNCH

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

REMOVABLE DOWEL-PINS—2



This form of removable dowel-pin has proved satisfactory for use on certain machine tools, steam turbines, and many types of heavy-duty machines. It was originally designed for aligning two flanges which are held together by studs. In assembling the parts, the dowels are driven in and nuts are screwed on the projecting ends and tightened just enough to hold them in position. The dowels should be oiled before insertion to prevent corrosion.

Stock Length A, Inches	Pin No. 10			Pin No. 11			Pin No. 12		
	B	d	Drill Diam., Inches	B	d	Drill Diam., Inches	B	d	Drill Diam., Inches
2 1/4	1 1/4	0.659	21/32	.....	.....	.....	.....	.....	.....
2 1/2	1 1/2	0.654	21/32	1 3/8	0.808	13/16	1 3/8	0.890	63/64
2 3/4	1 3/4	0.649	21/32	1 5/8	0.803	13/16	1 5/8	0.974	31/32
3	2	0.643	41/64	1 7/8	0.797	51/64	1 7/8	0.969	31/32
3 1/4	2 1/4	0.638	41/64	2 1/8	0.792	51/64	2 1/8	0.964	31/32
3 1/2	2 1/2	0.633	41/64	2 3/8	0.787	25/32	2 3/8	0.959	61/64
3 3/4	2 3/4	0.628	5/8	2 5/8	0.782	25/32	2 5/8	0.954	61/64
4	3	0.623	5/8	2 7/8	0.777	25/32	2 7/8	0.949	61/64
4 1/4	3 1/4	0.617	5/8	3 1/8	0.772	49/64	3 1/8	0.945	15/16
4 1/2	3 1/2	0.612	39/64	3 3/8	0.766	49/64	3 3/8	0.938	15/16
4 3/4	3 3/4	0.608	39/64	3 5/8	0.761	49/64	3 5/8	0.933	15/16
5	4	0.602	39/64	3 7/8	0.756	3/4	3 7/8	0.928	59/64
5 1/4	4 1/4	0.596	19/32	4 1/8	0.751	3/4	4 1/8	0.923	59/64
5 1/2	4 1/2	0.591	19/32	4 3/8	0.745	3/4	4 3/8	0.917	59/64
5 3/4	4 3/4	0.586	19/32	4 5/8	0.740	47/64	4 5/8	0.912	29/32
6	5	0.581	37/64	4 7/8	0.735	47/64	4 7/8	0.907	29/32

Common Dimensions

Pin No.	C	D	D_2	E	F	G	H	K	L
10	1	0.685	0.706	5/8	1/2	35/64	3/4	3/32	9/32
11	1 1/8	0.837	0.860	3/4	5/8	21/32	7/8	1/8	9/32
12	1 1/8	1.009	1.032	3/4	5/8	21/32	7/8	1/8	5/16

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MACHINERY'S Data Sheet No. 74, New Series, January, 1926 Contributed by R. L. Flanagan

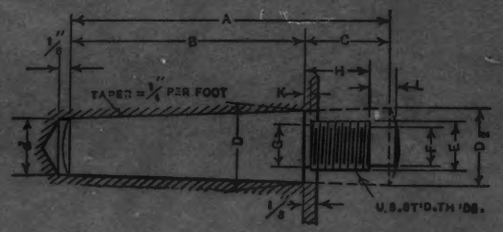
CUT HERE

MACHINERY'S Data Sheet No. 73, New Series, January, 1926 Contributed by R. L. Flanagan

PUNCH ○ ○ PUNCH

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

REMOVABLE DOWEL-PINS 1



The removable dowel-pins listed in this and the following table are intended for use in "blind holes." These pins differ from standard dowel-pins in that provision is made for drawing them from a blind hole merely by turning the nut which is placed over the threaded end. Since it has been found impractical to use a nut smaller than 3/8 inch on pins of this type, the No. 7 standard size is the smallest one listed. The removable dowel-pin is not recommended where a plain taper pin or "knock-out" pin can be used.

Stock Length A, Inches	Pin No. 7			Pin No. 8			Pin No. 9		
	B	d	Drill Diam., Inches	B	d	Drill Diam., Inches	B	d	Drill Diam., Inches
1 3/4	1	0.372	3/8	1	0.455	29/64	.....	.....	.....
2	1 1/4	0.367	3/8	1 1/4	0.450	29/64	1 1/8	0.549	35/64
2 1/4	1 1/2	0.362	23/64	1 1/2	0.445	29/64	1 3/8	0.544	35/64
2 1/2	1 3/4	0.356	23/64	1 3/4	0.440	7/16	1 5/8	0.539	35/64
2 3/4	2	0.351	23/64	2	0.434	7/16	1 7/8	0.534	17/32
3	2 1/4	0.346	11/32	2 1/4	0.429	7/16	2 1/8	0.528	17/32
3 1/4	2 1/2	0.340	11/32	2 1/2	0.424	27/64	2 3/8	0.523	17/32
3 1/2	2 3/4	0.335	11/32	2 3/4	0.419	27/64	2 5/8	0.518	33/64
3 3/4	3	0.330	21/64	3	0.414	27/64	2 7/8	0.513	33/64
4	3 1/4	0.326	21/64	3 1/4	0.409	13/32	3 1/8	0.508	33/64
4 1/4	3 1/2	0.321	21/64	3 1/2	0.403	13/32	3 3/8	0.502	1/2
4 1/2	3 3/4	0.315	5/16	3 3/4	0.398	13/32	3 5/8	0.497	1/2
4 3/4	4	0.310	5/16	4	0.393	25/64	3 7/8	0.493	1/2
5	4 1/4	0.305	5/16	4 1/4	0.389	25/64	4 1/8	0.487	31/64
5 1/4	4 1/2	0.299	19/64	4 1/2	0.383	25/64	4 3/8	0.482	31/64
5 1/2	4 3/4	0.294	19/64	4 3/4	0.377	3/8	4 5/8	0.476	31/64
5 3/4	5	0.289	19/64	5	0.372	3/8	4 7/8	0.471	15/32
6	5 1/4	0.284	9/32	5 1/4	0.367	3/8	5 1/8	0.466	15/32

Common Dimensions

Pin No.	C	D	D_2	E	F	G	H	K	L
7	3/4	0.393	0.409	3/8	5/16	21/64	1/2	1/16	17/64
8	3/4	0.476	0.492	3/8	5/16	21/64	1/2	1/16	9/32
9	7/8	0.573	0.591	1/2	3/8	7/16	5/8	3/32	9/32

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MACHINERY'S DATA SHEETS Nos. 73 and 74

PUNCH
PUNCH
PUNCH
CUT OUT ON THIS LINE

MACHINERY'S DATA SHEETS Nos. 75 and 76

TURNING MOMENT FOR GIVEN SPEED AND HORSEPOWER

H.P.	Revolutions per Minute													
	1800	1500	1200	900	750	600	500	400	300	200	150	100	75	50
	Turning Moment in Inch-pounds													
1/2	17.5	21	26	35	42	52.5	63	79	105	158	210	315	420	630
1	35	42	53	70	84	105	126	158	210	315	420	630	840	1261
2	70	84	105	140	168	210	252	315	420	630	840	1260	1681	2521
3	105	126	158	210	252	315	378	473	630	945	1261	1891	2521	3782
5	175	210	263	350	420	525	630	788	1050	1576	2101	3151	4202	6303
7 1/2	263	315	394	525	630	788	945	1182	1576	2363	3151	4727	6303	9454
10	350	420	525	700	840	1050	1261	1576	2101	3151	4202	6303	8403	12,605
15	525	630	788	1050	1261	1576	1891	2364	3151	4727	6303	9454	12,605	18,908
20	700	840	1050	1401	1681	2101	2521	3151	4202	6303	8403	12,605	16,807	25,210
25	876	1050	1313	1751	2101	2626	3151	3939	5252	7878	10,504	15,756	21,008	31,513
30	1050	1261	1576	2101	2521	3151	3782	4727	6303	9454	12,605	18,908	25,210	37,815
40	1401	1681	2101	2801	3361	4202	5042	6303	8403	12,605	16,807	25,210	33,614	50,420
50	1751	2101	2626	3502	4202	5252	6303	7878	10,504	15,756	21,008	31,513	42,017	63,025
60	2101	2521	3152	4202	5042	6303	7563	9454	12,605	18,908	25,210	37,815	50,420	75,630
75	2626	3152	3939	5252	6303	7878	9454	11,817	15,756	23,634	31,513	47,269	63,025	94,538
90	3151	3782	4727	6303	7563	9454	11,345	14,181	18,908	28,361	37,815	56,723	75,630	113,445
100	3502	4202	5252	7003	8403	10,504	12,605	15,756	21,008	31,513	42,017	63,025	84,034	126,050
125	4377	5252	6565	8754	10,504	13,130	15,756	19,695	26,261	39,391	52,521	78,782	105,042	157,563
150	5252	6303	7878	10,504	12,605	15,756	18,908	23,635	31,513	47,269	63,025	94,538	126,050	189,076
200	7003	8403	10,504	14,006	16,807	21,008	25,210	31,513	42,017	63,025	84,024	126,050	168,968	252,101

Example—A pulley 12 inches in diameter transmits 15 horsepower at 900 R.P.M., what is the tensional pull on the belt?

The equivalent turning moment is 1050 inch-pounds (see table) and the pulley radius 6 inches; hence the tensional pull = 1050 ÷ 6 = 175 pounds.

Example—If a spur gear having a pitch radius of 5 inches transmits 2 horsepower at 300 R.P.M., what is the tangential load on the gear teeth?

According to the table, the equivalent turning moment is 420 inch-pounds; hence the tangential load = 420 ÷ 5 = 84 pounds.

MACHINERY'S Data Sheet No. 75, New Series, February, 1926 Contributed by K. T. Sorensen

CUT HERE

CLEARANCE HOLES FOR COUNTERSUNK SCREWS IN THIN STOCK

If stock does not conform to American or B. & S. gage, use the hole diameter for the nearest stock thickness given in the table. For thicker stock than specified, use standard clearance diameters. For drilled holes, use the sizes nearest to those given in the table. Diameters of holes conform to Stub's Steel Wire Gage (except certain fractional sizes) owing to common use of this standard in making punches for dies.

Thickness of Stock		Outside Diameter of Screw (A.S.M.E. Standard)													
American or B & S Gage	Inch	0.060	0.073	0.086	0.099	0.112	0.125	0.138	0.151	0.164	0.177	0.190	0.216	0.242	0.268
		Diameters (D) of Holes, Inches—Stub's Steel Wire Gage and Fractional Sizes													
24	0.020	0.099	1/8	0.151	0.178	0.204	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	0.0225	0.095	0.120	0.148	0.172	0.199	0.227	0.250	.....	.....	.....	.....	.....	.....	.....
22	0.025	0.092	0.115	0.143	0.168	0.197	0.219	0.250	.....	.....	.....	.....	.....	.....	.....
21	0.028	0.085	0.112	0.139	0.164	0.191	0.219	0.242	0.272	.....	.....	.....	.....	.....	.....
20	0.0319	.....	0.106	0.127	0.157	0.185	0.212	0.238	0.261	0.290	.....	.....	.....	.....	.....
19	0.0358	.....	0.099	1/8	0.151	0.178	0.204	0.227	0.257	0.281	5/16	0.332	.....	.....	.....
18	0.040	.....	.....	0.115	0.143	0.172	0.197	0.219	0.250	0.277	0.302	21/64	0.377	.....	.....
17	0.045	.....	.....	0.108	0.134	0.161	0.188	0.212	0.242	0.266	0.295	0.316	3/8	27/64	.....
16	0.0508	.....	.....	.....	1/8	0.153	0.178	0.204	0.227	0.257	0.281	5/16	0.353	0.413	15/32
15	0.057	.....	.....	.....	.....	0.143	0.168	0.194	0.219	0.246	0.272	0.302	0.348	0.404	29/64
14	0.064	.....	.....	.....	.....	.....	0.155	0.180	0.207	0.234	0.261	0.290	0.339	25/64	7/16
13	0.0719	.....	.....	.....	.....	.....	.....	0.168	0.194	0.219	0.246	0.272	0.323	0.377	27/64
12	0.0808	.....	.....	.....	.....	.....	.....	0.151	0.178	0.204	0.234	0.257	5/16	23/64	0.413
11	0.0907	.....	.....	.....	.....	.....	.....	.....	.....	0.188	0.212	0.238	0.290	11/32	0.397
10	0.1018	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.219	0.272	0.323	0.377
9	0.114	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.250	0.302	0.358
8	0.128	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.281	0.332
7	0.144	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.302

MACHINERY'S Data Sheet No. 76, New Series, February, 1926 Contributed by Bernard J. Wolfe

CUT OUT ON THIS LINE

PUNCH ○ Punch holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

PUNCH ○ Punch holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

TUBE-SHEET DIAMETER FOR GIVEN NUMBER OF TUBES

APPLICATION OF TABLE

In designing steam boilers, tubular condensers, or feed-water heaters, the designer generally first calculates the number of square feet of heating or cooling surface required, and having decided upon the most desirable tube diameters and their lengths, then determines the minimum tube-sheet diameter which will accommodate the requisite number of tubes. By the use of the table below, it is a simple matter to determine the diameter of the circle or tube-sheet that will accommodate the required number of holes or tubes of a given diameter, with any desired "bridge" or thickness of metal between the tubes.

In general, if N represents the number of points on one side of a hexagon, A the number of points along the maximum diameter of the hexagon, and S the total number of points or intersections, then it can be shown mathematically, that

$$A = 2N - 1$$

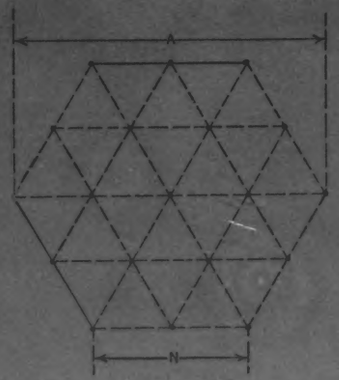
$$S = 3N\,(N - 1) + 1$$

Example—Determine the inside diameter of a tubular condenser containing 165 copper tubes, 1 5/8 inches in diameter, allowing 1/2 inch between the tubes and 1 inch between the tubes and the condenser shell.

The table shows that a hexagon containing 8 holes per side will have 15 holes on the long diameter of the figure, and a total of 169 holes. The diameter of the condenser is then, approximately,

$$D = 15 \times 1\ 5/8 + 14 \times 1/2 + 2 \times 1 = 33\ 3/8 \text{ inches}$$

The four unnecessary holes in the tube-sheet may readily be omitted without changing the diameter of the condenser. In some cases, it may be advisable to select a hexagon from the table containing fewer holes than that actually desired, and add the few extra holes required in the most desirable locations, such as would be at once apparent on laying out the selected hexagon. In each case where this system of laying out is employed, one of the tube holes is located at the exact center of the tube-sheet or hexagon, forming a convenient means for centering the tube-sheets.

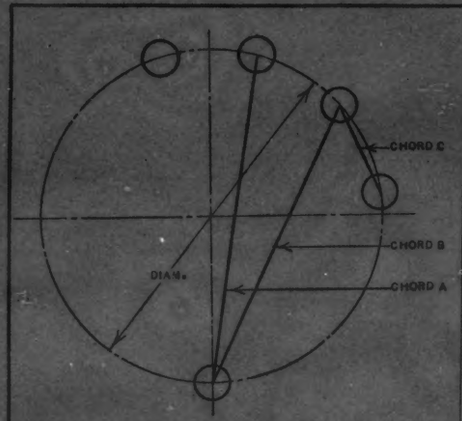


Number of Holes					
Total No.	Along Diam.	Along Side	Total No.	Along Diam.	Along Side
7	3	2	817	33	17
19	5	3	919	35	18
37	7	4	1027	37	19
61	9	5	1141	39	20
91	11	6	1261	41	21
127	13	7	1387	43	22
169	15	8	1519	45	23
217	17	9	1657	47	24
271	19	10	1801	49	25
331	21	11	1951	51	26
397	23	12	2107	53	27
469	25	13	2269	55	28
547	27	14	2437	57	29
631	29	15	2611	59	30
721	31	16	....	..	..

Contributed by Jacob Young

MACHINERY'S Data Sheet No. 77, New Series, March, 1926

CHORDAL DIMENSIONS FOR TOOLMAKERS



Number of Divisions	Chords, Inches		
	A	B	C
1	0.00000	0.00000	0.00000
2	1.00000	1.00000	1.00000
3	0.86603	0.86603	0.86603
4	1.00000	0.70710	0.70710
5	0.95106	0.58778	0.58778
6	1.00000	0.86603	0.50000
7	0.97493	0.78183	0.43388
8	1.00000	0.92388	0.38268
9	0.98481	0.86603	0.34202
10	1.00000	0.95105	0.30901
11	0.98982	0.90963	0.28173
12	1.00000	0.96592	0.25881
13	0.99271	0.93501	0.23931
14	1.00000	0.97492	0.22251
15	0.99452	0.95105	0.20791
16	1.00000	0.98078	0.19509
17	0.99573	0.96182	0.18374
18	1.00000	0.98480	0.17364
19	0.99658	0.96940	0.16459
20	1.00000	0.98768	0.15643
21	0.99720	0.97492	0.14904
22	1.00000	0.99010	0.14231
23	0.99766	0.97908	0.13616
24	1.00000	0.99144	0.13052
25	0.99803	0.98228	0.12533
26	1.00000	0.99270	0.12053
27	0.99831	0.98480	0.11609
28	1.00000	0.99371	0.11196
29	0.99853	0.98682	0.10811
30	1.00000	0.99452	0.10452
31	0.99871	0.98847	0.10116
32	1.00000	0.99518	0.09801
33	0.99886	0.98982	0.09505
34	1.00000	0.99573	0.09226
35	0.99899	0.99095	0.08963
36	1.00000	0.99619	0.08715
37	0.99910	0.99192	0.08480
38	1.00000	0.99658	0.08257
39	0.99918	0.99269	0.08046
40	1.00000	0.99691	0.07845
41	0.09926	0.99338	0.07654
42	1.00000	0.99720	0.07473
43	0.99933	0.99355	0.07299
44	1.00000	0.99745	0.07133
45	0.99939	0.99452	0.06975
46	1.00000	0.99766	0.06824
47	0.99944	0.99497	0.06679
48	1.00000	0.99785	0.06540
49	0.99948	0.99539	0.06406
50	1.00000	0.99802	0.06279

This table gives chordal dimensions for a diameter of 1 inch. For any other diameter, multiply the chord given in the table by the given diameter.

In the diagram, A represents longest chord; B second longest chord; and C, shortest chord. If

N = number of divisions, then

$A = \cos \frac{90}{N}$ for odd numbers, and 1 for even numbers

$B = \cos \frac{270}{N}$ for odd numbers and $\cos \frac{180}{N}$ for even numbers; $C = \sin \frac{180}{N}$

Example—A drill jig is to have 9 holes equally spaced on a 10-inch circle.

$A = 0.98481 \times 10 = 9.8481$ inches; $B = 0.86603 \times 10 = 8.6603$ inches; and $C = 0.34202 \times 10 = 3.4202$ inches.

Contributed by W. A. Morgenroth and George W. Morgenroth

MACHINERY'S DATA SHEETS Nos. 77 and 78

MACHINERY'S DATA SHEETS Nos. 79 and 80

MODIFIED CENTER DISTANCES FOR SPUR GEARS—1

For center-to-center distances other than standard, the working depth of spur gear teeth should be modified, thus permitting a variation from the standard center distance without introducing backlash. Upper section of table in Data Sheet No. 80 is for center distances greater than standard, and lower section for distances less than standard. This table is for gears generated by hob or rack-cutter only.

Notation: R = a ratio used in finding modified depth; n = number of teeth in pinion; N = number of teeth in gear; C_m = modified center distance; P = diametral pitch; P_c = circular pitch; D_p = pitch diameter of pinion; D_g = pitch diameter of gear; W = standard working depth; W_m = modified working depth; O_p = outside diameter of pinion; O_g = outside diameter of gear. Example illustrates use of formulas.

$$R = \frac{2C_m \times P}{n + N} \quad (1)$$

$$R = \frac{2C_m \times 3.1416}{P_c\,(n + N)} \quad (2)$$

$$W_m = W - \frac{x\,(n + N)}{P} \quad (3)$$

$$W_m = W - \frac{x\,(n + N)\,P_c}{3.1416} \quad (4)$$

$$D_p = \frac{2C_m \times n}{n + N} \quad (5)$$

$$D_g = \frac{2C_m \times N}{n + N} \quad (6)$$

Example: A gear and pinion having 55 and 15 teeth, respectively, and 5 diametral pitch, are to have a center-to-center distance of 7.25 inches, instead of the standard distance of 7 inches. Find the modified working depth of the teeth and the outside diameters of the gear and pinion blanks. The pressure angle of the cutter is 14 1/2 degrees. First use Formula (1) to find R.

$$R = \frac{2 \times 7.25 \times 5}{15 + 55} = 1.036$$

The value of x for a ratio R of 1.035 equals 0.00389 (see Data Sheet No. 80). To facilitate finding the exact value of x, equivalent to a ratio R such as 1.036, values y have been provided.

First subtract 1.035 from 1.036, the former being the ratio given in the table, and the latter the one determined by Formula (1). Thus, 1.036 — 1.035 = 0.001. Now, as y represents the amount (per thousandth difference between the given and calculated values of R) to increase the given value of x to obtain the true value, the amount y to add to x in this case equals 0.00022, since there is a difference of one thousandth only; hence, $x = 0.00389 + 0.00022 = 0.00411$. Now using Formula (3),

$$W_m = 0.4 - \frac{0.00411\,(15 + 55)}{5} = 0.342$$

This modified depth W_m is next added to the pitch diameters obtained with Formulas (5) and (6), to determine the outside diameters. Thus:

$$O_p = \frac{14.5 \times 15}{70} + 0.342 = 3.449 \text{ inches}$$

$$O_g = \frac{14.5 \times 55}{70} + 0.342 = 11.735 \text{ inches}$$

For center distances less than standard, which require the use of the lower section of Data Sheet No. 80, y is subtracted instead of being added in finding the correct value of x. Thus, if the exact ratio is, say, 0.961, and the pressure angle 20 degrees, the equivalent value of x is determined as follows: 0.962 — 0.960 = 0.002. Then, the amount y subtracted from x per thousandth difference = 0.00018; hence, $x = 0.00360 - 2 \times 0.00018 = 0.00324$. The entire procedure otherwise is the same as explained for increased center distances.

MACHINERY'S Data Sheet No. 79, New Series, April, 1926 Contributed by Harry E. Kitchen

MODIFIED CENTER DISTANCES FOR SPUR GEARS—2

Instructions for Using Given on Preceding Sheet

Center-to-center Distances Greater than Standard

R	Pressure Angle, Degrees					
	14½		18		20	
	x	y	x	y	x	y
1.005	0.00011	0.00005	0.00006	0.00003	0.00005	0.00003
1.010	0.00037	0.00008	0.00022	0.00006	0.00018	0.00005
1.015	0.00079	0.00012	0.00051	0.00007	0.00041	0.00006
1.020	0.00135	0.00015	0.00088	0.00009	0.00069	0.00008
1.025	0.00208	0.00017	0.00134	0.00011	0.00108	0.00009
1.030	0.00292	0.00019	0.00191	0.00012	0.00155	0.00011
1.035	0.00389	0.00022	0.00252	0.00015	0.00208	0.00012
1.040	0.00498	0.00024	0.00328	0.00016	0.00266	0.00013
1.045	0.00618	0.00026	0.00410	0.00018	0.00333	0.00015
1.050	0.00751	0.00027	0.00500	0.00019	0.00406	0.00016
1.055	0.00887	0.00031	0.00594	0.00021	0.00485	0.00017
1.060	0.01043	0.00032	0.00701	0.00022	0.00572	0.00018
1.065	0.01204	0.00034	0.00809	0.00023	0.00662	0.00019
1.070	0.01374	0.00036	0.00928	0.00025	0.00757	0.00021
1.075	0.01555	.....	0.01051	.....	0.00861	.....

Center-to-center Distances Less than Standard

R	Pressure Angle, Degrees					
	14½		18		20	
	x	y	x	y	x	y
0.955	.....	.....	.....	.....	0.00470	0.00022
0.960	.....	.....	.....	.....	0.00360	0.00018
0.965	.....	.....	0.00358	0.00022	0.00269	0.00015
0.970	.....	.....	0.00248	0.00017	0.00192	0.00012
0.975	.....	.....	0.00165	0.00012	0.00130	0.00009
0.980	0.00175	0.00016	0.00103	0.00009	0.00083	0.00007
0.985	0.00096	0.00010	0.00057	0.00006	0.00046	0.00006
0.990	0.00042	0.00007	0.00025	0.00004	0.00018	0.00003
0.995	0.00009	0.00002	0.00005	0.00001	0.00004	0.00001

MACHINERY'S Data Sheet No. 80, New Series, April, 1926 Contributed by Harry E. Kitchen

MACHINERY'S DATA SHEETS Nos. 81 and 82

PLAIN MILLING AND SLITTING CUTTERS

Sizes Accepted by Leading Cutter Manufacturers to Promote Simplified Practice

PLAIN MILLING CUTTERS

Cutters of less than three-fourths inch face have straight teeth. Cutters of three-fourths inch face and over have spiral teeth. Nicked teeth, or dimensions other than listed, are special. All dimensions in inches.

Cutter Diameter	Width of Face	Size of Hole	Cutter Diameter	Width of Face	Size of Hole	Cutter Diameter	Width of Face	Size of Hole
2 1/4	1/2	7/8	3	1/4	1	4	1/4	1
2 1/4	1	7/8	3	5/16	1	4	1/4	1 1/4
2 1/2	3/16	1	3	3/8	1	4	5/16	1
2 1/2	1/4	1	3	3/8	1 1/4	4	5/16	1 1/4
2 1/2	5/16	1	3	7/16	1 1/4	4	3/8	1
2 1/2	3/8	1	3	1/2	1 1/4	4	3/8	1 1/4
2 1/2	7/16	1	3	5/8	1 1/4	4	7/16	1 1/4
2 1/2	1/2	1	3	3/4	1 1/4	4	1/2	1 1/4
2 1/2	5/8	1	3	7/8	1 1/4	4	5/8	1 1/4
2 1/2	3/4	1	3	1	1 1/4	4	3/4	1 1/4
2 1/2	7/8	1	3	1 1/4	1 1/4	4	7/8	1 1/4
2 1/2	1	1	3	1 1/2	1 1/4	4	1	1 1/4
2 1/2	1 1/4	1	3	1 3/4	1 1/4	4	1 1/4	1 1/4
2 1/2	1 1/2	1	3	2	1 1/4	4	1 1/2	1 1/4
2 1/2	1 3/4	1	3	2 1/2	1 1/4	4	2	1 1/4
2 1/2	2	1	3	3	1 1/4	4	3	1 1/4
2 1/2	2 1/2	1	3	3 1/2	1 1/4	4	4	1 1/4
2 1/2	3	1	3	4	1 1/4			
2 1/2	4	1	3	5	1 1/4			
3	3/16	1	3	6	1 1/4			

METAL SLITTING CUTTERS

Metal slitting cutters are ground concave on the sides for clearance. Cutters having dimensions other than listed are special. All dimensions in inches.

Cutter Diameter	Thickness	Size of Hole	Cutter Diameter	Thickness	Size of Hole	Cutter Diameter	Thickness	Size of Hole
2 1/2	1/32	7/8	4	3/64	1	6	3/32	1
2 1/2	3/64	7/8	4	1/16	1	6	1/8	1
2 1/2	1/16	7/8	4	3/32	1	6	1/8	1 1/4
2 1/2	3/32	7/8	4	1/8	1	6	3/16	1
2 1/2	1/8	7/8	4	5/32	1	6	3/16	1 1/4
2 1/2	5/32	7/8	4	3/16	1	7	1/16	1
3	1/32	1	5	1/16	1	7	3/32	1
3	3/64	1	5	3/32	1	7	1/8	1
3	1/16	1	5	1/8	1	7	1/8	1 1/4
3	3/32	1	5	1/8	1 1/4	7	3/16	1 1/4
3	1/8	1	5	5/32	1	8	1/8	1
3	5/32	1	5	3/16	1	8	1/8	1 1/4
4	1/32	1	6	1/16	1	8	3/16	1 1/4

MACHINERY'S Data Sheet No. 81, New Series, May, 1926

SIDE MILLING AND INSERTED-BLADE CUTTERS

Sizes Accepted by Leading Cutter Manufacturers to Promote Simplified Practice

SIDE MILLING CUTTERS

Cutters having dimensions other than listed are special. All dimensions in inches.

Diameter	Width of Face	Size of Hole	Diameter	Width of Face	Size of Hole	Diameter	Width of Face	Size of Hole
2	3/16	1/2	3	1/2	1	5	1/2	1
2	3/16	5/8	3 1/2	7/16	1	5	1/2	1 1/4
2	1/4	1/2	3 1/2	1/2	1	5	5/8	1
2	1/4	5/8	3 1/2	9/16	1	5	5/8	1 1/4
2	3/8	1/2	3 1/2	5/8	1	5	3/4	1
2	3/8	5/8	4	1/4	1	5	3/4	1 1/4
2 1/2	1/4	7/8	4	3/8	1	5	1	1
2 1/2	5/16	7/8	4	1/2	1	5	1	1 1/4
2 1/2	3/8	7/8	4	1/2	1 1/4	6	1/2	1
2 1/2	7/16	7/8	4	5/8	1	6	3/4	1
2 1/2	1/2	7/8	4	5/8	1 1/4	6	3/4	1 1/4
3	1/4	1	4	3/4	1	6	1	1 1/4
3	5/16	1	4	3/4	1 1/4	7	3/4	1 1/4
3	3/8	1	4	7/8	1	7	1	1 1/4
3	7/16	1	4	7/8	1 1/4	8	1	1 1/4

COARSE-TOOTH SIDE MILLING CUTTERS

Cutters having dimensions other than listed are special. Coarse-tooth side milling cutters of carbon steel are special. All dimensions in inches.

Diameter	Width of Face	Size of Hole	Diameter	Width of Face	Size of Hole	Diameter	Width of Face	Size of Hole
3	3/8	1 1/4	4	3/4	1 1/4	5	7/8	1 1/4
3	7/16	1 1/4	4	3/4	1 1/2	5	7/8	1 1/2
3	1/2	1 1/4	4	7/8	1 1/4	5	1	1 1/2
4	1/2	1 1/4	4	7/8	1 1/2	6	3/4	1 1/2
4	1/2	1 1/2	5	3/4	1 1/4	6	1	1 1/2
4	5/8	1 1/4	5	3/4	1 1/2	8	1	1 1/2
4	5/8	1 1/2						

INSERTED-BLADE CUTTERS

Inserted-blade cutters are regularly furnished with high-speed steel blades. The side cutters have the blades set straight, while the face cutters have the blades set at an angle. Face milling cutters have a taper hole and keyway and will be furnished either right- or left-hand. Inserted-blade cutters with carbon steel blades are special. All dimensions in inches.

SIDE MILLING CUTTERS			FACE MILLING CUTTERS			
Diameter	Width of Face	Size of Hole	Diameter	Cutting Faces of Blades: Width	Cutting Faces of Blades: Depth	Number of B. & S. Taper Hole
6	2	1 1/4	5 1/2	2 1/4	1 1/16	10
7	2	1 1/4	5 1/2	2 1/4	1 1/16	12
7	2	1 3/4	6 1/2	2 1/4	1 1/16	10
8	2	1 1/2	6 1/2	2 1/4	1 1/16	12
8	2	2	7 1/2	2 1/4	1 1/16	12
9	2	1 1/2	8 1/2	2 1/4	1 3/16	12
10	2	1 1/2	9 1/2	2 1/4	1 3/16	12

MACHINERY'S Data Sheet No. 82, New Series, May, 1926

MACHINERY'S DATA SHEETS Nos. 83 and 84

DIMENSIONS OF END-MILLS—1

Sizes Accepted by Leading Cutter Manufacturers to Promote Simplified Practice

STRAIGHT-CUT END-MILLS WITH MORSE TAPER SHANKS

These end-mills are furnished regularly right-hand. End-mills having dimensions other than listed and left-hand end-mills are special. All dimensions in inches

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	1	13/16	3 5/8	5/8	2	1 1/2	5
5/16	1	7/8	3 11/16	3/4	2	1 5/8	5 1/8
3/8	1	7/8	3 11/16	3/4	3	1 5/8	5 15/16
7/16	1	15/16	3 3/4	7/8	2	1 3/4	5 1/4
7/16	2	1	4 1/2	7/8	3	1 3/4	6 1/16
1/2	1	1	3 13/16	1	2	1 7/8	5 3/8
1/2	2	1 1/8	4 5/8	1	3	1 7/8	6 3/16

STRAIGHT-CUT END-MILLS WITH BROWN & SHARPE TAPER SHANKS

These end-mills are regularly furnished either right- or left-hand. End-mills having dimensions other than listed are special. All dimensions in inches.

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	13/16	2 7/16	1/2	7	1 1/8	5 1/8
1/4	5	13/16	3	5/8	5	1 1/4	3 7/16
5/16	4	7/8	2 1/2	5/8	7	1 1/2	5 1/2
5/16	5	7/8	3 1/16	3/4	7	1 5/8	5 5/8
3/8	4	7/8	2 1/2	7/8	7	1 3/4	5 3/4
3/8	5	7/8	3 1/16	1	7	1 7/8	5 7/8
7/16	4	15/16	2 9/16	1 1/8	9	2	7 1/4
7/16	5	15/16	3 1/8	1 1/4	9	2	7 1/4
1/2	5	1	3 3/16				

SPIRAL-CUT END-MILLS WITH MORSE TAPER SHANKS

These end-mills are regularly furnished right-hand. End-mills having dimensions other than listed and left-hand end-mills are special. All dimensions in inches.

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	1	13/16	3 5/8	3/4	3	1 5/8	5 1/8
5/16	1	7/8	3 11/16	3/4	3	1 5/8	5 15/16
3/8	1	7/8	3 11/16	7/8	2	1 3/4	5 1/4
7/16	1	15/16	3 3/4	7/8	3	1 3/4	6 1/16
7/16	2	1	4 1/2	1	2	1 7/8	5 3/8
1/2	1	1	3 13/16	1	3	1 7/8	6 3/16
1/2	2	1 1/8	4 5/8	1 1/8	3	2	6 5/16
5/8	2	1 1/2	5	1 1/4	3	2	6 5/16

MACHINERY'S Data Sheet No. 83, New Series, June, 1926

DIMENSIONS OF END-MILLS—2

SPIRAL-CUT END-MILLS WITH BROWN & SHARPE TAPER SHANKS

These end-mills are regularly furnished either right- or left-hand. End-mills having dimensions other than listed are special. All dimensions in inches.

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	13/16	2 7/16	3/4	7	1 5/8	5 5/8
1/4	5	13/16	3	3/4	9	1 5/8	6 7/8
5/16	4	7/8	2 1/2	7/8	7	1 3/4	5 3/4
5/16	5	7/8	3 1/16	7/8	9	1 3/4	7
3/8	4	7/8	2 1/2	1	7	1 7/8	5 7/8
3/8	5	7/8	3 1/16	1	9	1 7/8	7 1/8
7/16	4	15/16	2 9/16	1 1/8	7	2	6
7/16	5	15/16	3 1/8	1 1/8	9	2	7 1/4
1/2	5	1	3 3/16	1 1/4	9	2	7 1/4
1/2	7	1 1/8	5 1/8	1 3/8	9	2 1/8	7 3/8
5/8	7	1 1/2	5 1/2	1 1/2	9	2 1/4	7 1/2
3/4	7	1 5/8	5 5/8	1 5/8	9	2 3/8	7 5/8
3/4	9	1 5/8	6 7/8	1 3/4	9	2 1/2	7 3/4
11/16	7	1 1/2	5 1/2	.....	..	.....	.....

COARSE-TOOTH SPIRAL END-MILLS WITH B. & S. TAPER SHANKS

Carbon-steel coarse-tooth end-mills or those having dimensions other than listed are special. End-mills with tapped hole for drawback spindle are special. All dimensions in inches.

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	13/16	2 7/16	7/8	7	1 3/4	5 3/4
1/4	5	13/16	3	7/8	9	1 3/4	7
5/16	4	7/8	2 1/2	1	7	1 7/8	5 7/8
5/16	5	7/8	3 1/16	1	9	1 7/8	7 1/8
3/8	4	7/8	2 1/2	1 1/8	7	2	6
3/8	5	7/8	3 1/16	1 1/8	9	2	7 1/4
7/16	5	15/16	3 1/8	1 1/4	7	2	6
1/2	5	1	3 3/16	1 1/4	9	2	7 1/4
1/2	7	1 1/8	5 1/8	1 3/8	9	2 1/8	7 3/8
5/8	7	1 1/2	5 1/2	1 1/2	9	2 1/4	7 1/2
3/4	7	1 5/8	5 5/8	1 5/8	9	2 3/8	7 5/8
3/4	9	1 5/8	6 7/8	1 3/4	9	2 1/2	7 3/4

STRAIGHT-SHANK END-MILLS

Straight-shank end-mills under three-eighths inch diameter have straight teeth; three-eighths inch diameter and over have spiral teeth. All dimensions in inches.

Diameter	Length of Cut	Length Over-all	Diameter	Length of Cut	Length Over-all	Diameter	Length of Cut	Length Over-all
1/8	5/16	1 1/4	1/4	3/4	1 7/8	1/2	15/16	2 1/4
5/32	5/16	1 1/4	5/16	13/16	1 15/16	9/16	15/16	2 5/16
3/16	9/16	1 1/2	3/8	13/16	2	5/8	1	2 3/8
7/32	9/16	1 1/2	7/16	7/8	2 1/8	3/4	1 1/8	2 15/16

MACHINERY'S Data Sheet No. 84, New Series, June, 1926

MACHINERY'S DATA SHEETS Nos. 85 and 86

SCREW MACHINE RUNNING COST PER THOUSAND PIECES—1

Sec. per Piece	Production: Gross 10 Hours	Production: Net 1 Hour	Hours per 1000	Machine-Hour Rate, Dollars: 0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60
1/2	72,000	5000	0.2	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
1	36,000	30%* 2500	0.4	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24
1 1/2	24,000	1700	0.6	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.33	0.36
2	18,000	1350	0.8	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40	0.44	0.48
2 1/2	14,400	25%* 1080	1.0	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60
3	12,000	900	1.1	0.06	0.11	0.16	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.61	0.66
3 1/2	10,300	820	1.2	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60	0.66	0.72
4	9,000	720	1.4	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70	0.77	0.84
4 1/2	8,000	20%* 640	1.6	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96
5	7,200	570	1.8	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90	0.99	1.08
6	6,000	480	2.1	0.11	0.21	0.32	0.42	0.53	0.63	0.73	0.84	0.95	1.05	1.16	1.26
7	5,100	430	2.3	0.12	0.23	0.35	0.46	0.58	0.69	0.81	0.92	1.04	1.15	1.27	1.38
8	4,500	380	2.7	0.14	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.49	1.62
9	4,000	15%* 340	3.0	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65	1.80
10	3,600	300	3.4	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
11	3,300	280	3.6	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.98	2.16
12	3,000	260	3.9	0.20	0.39	0.59	0.78	0.98	1.17	1.37	1.56	1.76	1.95	2.15	2.34
13	2,750	240	4.2	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10	2.31	2.52
14	2,570	230	4.4	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	2.42	2.64
15	2,400	210	4.8	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16	2.40	2.64	2.88
16	2,250	200	5.0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
18	2,000	180	5.6	0.28	0.56	0.84	1.12	1.40	1.68	1.96	2.24	2.52	2.80	3.08	3.36
20	1,800	160	6.3	0.32	0.63	0.95	1.26	1.58	1.89	2.21	2.52	2.84	3.15	3.47	3.78
22	1,640	150	6.7	0.34	0.67	1.00	1.34	1.68	2.01	2.35	2.68	3.02	3.35	3.69	4.02
24	1,500	130	7.7	0.39	0.77	1.16	1.54	1.93	2.31	2.70	3.08	3.47	3.85	4.24	4.62
26	1,380	10%* 120	8.4	0.42	0.84	1.26	1.68	2.10	2.52	2.94	3.36	3.78	4.20	4.62	5.04
28	1,280	115	8.7	0.44	0.87	1.30	1.74	2.18	2.61	3.05	3.48	3.92	4.35	4.79	5.22
30	1,200	110	9.1	0.46	0.91	1.36	1.82	2.28	2.73	3.19	3.64	4.10	4.55	5.00	5.46
35	1,020	90	11.1	0.56	1.11	1.66	2.22	2.78	3.33	3.89	4.44	5.00	5.55	6.11	6.66
40	900	80	12.5	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25	6.88	7.50
45	800	72	14.0	0.70	1.40	2.10	2.80	3.50	4.20	4.90	5.60	6.30	7.00	7.70	8.40
50	720	65	15.4	0.77	1.54	2.30	3.08	3.85	4.62	5.39	6.16	6.93	7.70	8.47	9.24
55	650	58	17.2	0.86	1.72	2.57	3.44	4.30	5.16	6.02	6.88	7.74	8.60	9.46	10.32
60	600	54	18.6	0.93	1.86	2.78	3.72	4.65	5.58	6.51	7.44	8.37	9.30	10.23	11.16

* These percentages by which the gross production is reduced to get net production, are intended as a general guide only.

MACHINERY'S Data Sheet No. 85, New Series, July, 1926 Contributed by J. M. Hemphill

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SCREW MACHINE RUNNING COST PER THOUSAND PIECES—2

Sec. per Piece	Production: Gross 10 Hours	Production: Net 1 Hour	Hours per 1000	Machine-Hour Rate, Dollars: 0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20
1/2	72,000	5000	0.2	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24
1	36,000	30%* 2500	0.4	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
1 1/2	24,000	1700	0.6	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72
2	18,000	1350	0.8	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96
2 1/2	14,400	25%* 1080	1.0	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20
3	12,000	900	1.1	0.72	0.77	0.82	0.88	0.94	0.99	1.04	1.10	1.16	1.22	1.27	1.32
3 1/2	10,300	820	1.2	0.78	0.84	0.90	0.96	1.02	1.08	1.14	1.20	1.26	1.32	1.38	1.44
4	9,000	720	1.4	0.91	0.98	1.05	1.12	1.19	1.26	1.33	1.40	1.47	1.54	1.61	1.68
4 1/2	8,000	20%* 640	1.6	1.04	1.12	1.20	1.28	1.36	1.44	1.52	1.60	1.68	1.76	1.84	1.92
5	7,200	570	1.8	1.17	1.26	1.35	1.44	1.53	1.62	1.71	1.80	1.89	1.98	2.07	2.16
6	6,000	480	2.1	1.37	1.47	1.58	1.68	1.79	1.89	1.99	2.10	2.21	2.31	2.42	2.52
7	5,100	430	2.3	1.50	1.61	1.73	1.84	1.96	2.07	2.19	2.30	2.42	2.53	2.65	2.76
8	4,500	380	2.7	1.76	1.89	2.03	2.16	2.30	2.43	2.57	2.70	2.84	2.97	3.11	3.24
9	4,000	15%* 340	3.0	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.15	3.30	3.45	3.60
10	3,600	300	3.4	2.21	2.38	2.55	2.72	2.89	3.06	3.23	3.40	3.57	3.74	3.91	4.08
11	3,300	280	3.6	2.34	2.52	2.70	2.88	3.06	3.24	3.42	3.60	3.78	3.96	4.14	4.32
12	3,000	260	3.9	2.54	2.73	2.93	3.12	3.32	3.51	3.71	3.90	4.10	4.29	4.49	4.68
13	2,750	240	4.2	2.73	2.94	3.15	3.36	3.57	3.78	3.99	4.20	4.41	4.62	4.83	5.04
14	2,570	230	4.4	2.86	3.00	3.30	3.52	3.74	3.96	4.18	4.40	4.62	4.84	5.06	5.28
15	2,400	210	4.8	3.12	3.36	3.60	3.84	4.08	4.32	4.56	4.80	5.04	5.28	5.52	5.76
16	2,250	200	5.0	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
18	2,000	180	5.6	3.64	3.92	4.20	4.48	4.76	5.04	5.32	5.60	5.88	6.16	6.44	6.72
20	1,800	160	6.3	4.10	4.41	4.73	5.04	5.36	5.67	5.99	6.30	6.62	6.93	7.25	7.56
22	1,640	150	6.7	4.36	4.69	5.03	5.36	5.70	6.03	6.37	6.70	7.04	7.37	7.71	8.04
24	1,500	10%* 130	7.7	5.00	5.39	5.78	6.16	6.55	6.93	7.32	7.70	8.09	8.47	8.86	9.24
26	1,380	120	8.4	5.46	5.88	6.30	6.72	7.14	7.56	7.98	8.40	8.82	9.24	9.66	10.08
28	1,280	115	8.7	5.66	6.09	6.53	6.96	7.40	7.83	8.27	8.70	9.14	9.57	10.00	10.44
30	1,200	110	9.1	5.92	6.37	6.83	7.28	7.74	8.19	8.65	9.10	9.56	10.00	10.47	10.92
35	1,020	90	11.1	7.22	7.77	8.33	8.88	9.44	9.99	10.55	11.10	11.66	12.20	12.77	13.32
40	900	80	12.5	8.13	8.75	9.38	10.00	10.63	11.25	11.88	12.50	13.13	13.75	14.38	15.00
45	800	72	14.0	9.10	9.80	10.50	11.20	11.90	12.60	13.30	14.00	14.70	15.40	16.10	16.80
50	720	65	15.4	10.00	10.78	11.55	12.32	13.09	13.86	14.63	15.40	16.17	16.94	17.71	18.48
55	650	58	17.2	11.18	12.04	12.90	13.76	14.62	15.48	16.34	17.20	18.06	18.92	19.78	20.64
60	600	54	18.6	12.09	13.02	13.95	14.88	15.81	16.74	17.67	18.60	19.53	20.46	21.39	22.32

* These percentages by which the gross production is reduced to get net production, are intended as a general guide only.

MACHINERY'S Data Sheet No. 86, New Series, July, 1926 Contributed by J. M. Hemphill

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MACHINERY'S DATA SHEETS Nos. 87 and 88

SCREW MACHINE RUNNING COST PER THOUSAND PIECES—3

Sec. per Piece	Production: Gross 10 Hours	Production: Net 1 Hour		Hours per 1000	Machine-Hour Rate, Dollars: 1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75
1/2	72,000		5000	0.2	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35
1	36,000	30%*	2500	0.4	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70
1 1/2	24,000		1700	0.6	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05
2	18,000		1350	0.8	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40
2 1/2	14,400	25%*	1080	1.0	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75
3	12,000		900	1.1	1.38	1.43	1.49	1.54	1.59	1.65	1.70	1.76	1.81	1.87	1.92
3 1/2	10,300		820	1.2	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10
4	9,000		720	1.4	1.75	1.82	1.89	1.96	2.03	2.10	2.17	2.24	2.31	2.38	2.45
4 1/2	8,000	20%*	640	1.6	2.00	2.08	2.16	2.24	2.32	2.40	2.48	2.56	2.64	2.72	2.80
5	7,200		570	1.8	2.25	2.34	2.43	2.52	2.61	2.70	2.79	2.88	2.97	3.06	3.15
6	6,000		480	2.1	2.63	2.73	2.84	2.94	3.04	3.15	3.25	3.36	3.46	3.57	3.67
7	5,100		430	2.3	2.88	2.99	3.11	3.22	3.33	3.45	3.56	3.68	3.79	3.91	4.02
8	4,500		380	2.7	3.38	3.51	3.65	3.78	3.91	4.05	4.18	4.32	4.45	4.59	4.72
9	4,000	15%*	340	3.0	3.75	3.90	4.05	4.20	4.35	4.50	4.65	4.80	4.95	5.10	5.25
10	3,600		300	3.4	4.25	4.42	4.59	4.76	4.93	5.10	5.27	5.44	5.61	5.78	5.95
11	3,300		280	3.6	4.50	4.68	4.86	5.04	5.22	5.40	5.58	5.76	5.94	6.12	6.30
12	3,000		260	3.9	4.88	5.07	5.27	5.46	5.65	5.85	6.04	6.24	6.43	6.63	6.82
13	2,750		240	4.2	5.25	5.46	5.67	5.88	6.09	6.30	6.51	6.72	6.93	7.14	7.35
14	2,570		230	4.4	5.50	5.72	5.94	6.16	6.38	6.60	6.82	7.04	7.26	7.48	7.70
15	2,400		210	4.8	6.00	6.24	6.48	6.72	6.96	7.20	7.44	7.68	7.92	8.16	8.40
16	2,250		200	5.0	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.75
18	2,000		180	5.6	7.00	7.28	7.56	7.84	8.12	8.40	8.68	8.96	9.24	9.52	9.80
20	1,800		160	6.3	7.88	8.19	8.50	8.82	9.13	9.45	9.76	10.08	10.39	10.71	11.02
22	1,640		150	6.7	8.38	8.70	9.05	9.38	9.71	10.05	10.38	10.72	11.05	11.39	11.72
24	1,500	10%*	130	7.7	9.63	10.01	10.40	10.78	11.16	11.55	11.93	12.32	12.70	13.09	13.47
26	1,380		120	8.4	10.50	10.92	11.34	11.76	12.18	12.60	13.02	13.44	13.86	14.28	14.70
28	1,280		115	8.7	10.88	11.31	11.75	12.18	12.61	13.05	13.48	13.92	14.35	14.79	15.22
30	1,200		110	9.1	11.38	11.83	12.29	12.74	13.19	13.65	14.10	14.56	15.01	15.47	15.92
35	1,020		90	11.1	13.88	14.43	14.98	15.54	16.09	16.65	17.20	17.76	18.31	18.87	19.42
40	900		80	12.5	15.63	16.25	16.89	17.50	18.12	18.75	19.37	20.00	20.62	21.25	21.87
45	800		72	14.0	17.50	18.20	18.90	19.60	20.30	21.00	21.70	22.40	23.10	23.80	24.50
50	720		65	15.4	19.25	20.02	20.79	21.56	22.33	23.10	23.87	24.64	25.41	26.18	26.95
55	650		58	17.2	21.50	22.36	23.22	24.08	24.94	25.80	26.66	27.52	28.38	29.24	30.10
60	600		54	18.6	23.25	24.18	25.11	26.04	26.97	27.90	28.83	29.76	30.69	31.62	32.55

* These percentages by which the gross production is reduced to get net production, are intended as a general guide only.

MACHINERY'S Data Sheet No. 87, New Series, August, 1926 Contributed by J. M. Hemphill

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COST PER THOUSAND, GIVEN TOTAL NUMBER AND TOTAL COST

Total Number	Total Cost, Dollars: 2.00	4.00	6.00	8.00	10.00	15.00	20.00	25.00	30.00	40.00	50.00	60.00	80.00	100.00
400	5.00	10.00	15.00	20.00	25.00	37.50	50.00	62.50	75.00	100.00	125.00	150.00	200.00	250.00
600	3.30	6.70	10.00	13.30	16.60	25.00	33.40	41.70	50.00	66.80	83.50	100.00	133.00	166.00
800	2.50	5.00	7.50	10.00	12.50	18.75	25.00	31.25	37.50	50.00	62.50	75.00	100.00	125.00
1,000	2.00	4.00	6.00	8.00	10.00	15.00	20.00	25.00	30.00	40.00	50.00	60.00	80.00	100.00
1,200	1.70	3.35	5.00	6.65	8.35	12.50	16.70	20.80	25.00	33.40	41.70	50.00	67.00	83.50
1,400	1.45	2.85	4.30	5.70	7.20	10.70	14.20	17.80	21.40	28.50	35.60	43.00	57.60	72.00
1,600	1.25	2.50	3.75	5.00	6.30	9.40	12.50	15.60	18.80	25.00	31.20	37.60	50.00	63.00
1,800	1.10	2.25	3.35	4.45	5.55	8.35	11.10	13.90	16.70	22.30	27.80	33.30	44.50	55.50
2,000	1.00	2.00	3.00	4.00	5.00	7.50	10.00	12.50	15.00	20.00	25.00	30.00	40.00	50.00
2,500	0.80	1.60	2.40	3.20	4.00	6.00	8.00	10.00	12.00	16.00	20.00	24.00	32.00	40.00
3,000	0.70	1.35	2.00	2.70	3.35	5.00	6.70	8.35	10.00	13.40	16.75	20.00	26.70	33.50
3,500	0.60	1.15	1.70	2.30	2.85	4.30	5.70	7.10	8.55	11.40	14.30	17.10	22.80	28.50
4,000	0.50	1.00	1.50	2.00	2.50	3.75	5.00	6.25	7.50	10.00	12.50	15.00	20.00	25.00
4,500	0.45	0.90	1.35	1.80	2.20	3.35	4.45	5.55	6.65	8.90	11.10	13.30	17.60	22.00
5,000	0.40	0.80	1.20	1.60	2.00	3.00	4.00	5.00	6.00	8.00	10.00	12.00	16.00	20.00
6,000	0.35	0.65	1.00	1.35	1.65	2.50	3.30	4.15	5.00	6.65	8.30	10.00	13.30	16.50
7,000	0.30	0.60	0.85	1.15	1.45	2.15	2.85	3.55	4.30	5.70	7.25	8.70	11.60	14.50
8,000	0.25	0.50	0.75	1.00	1.25	1.88	2.50	3.13	3.75	5.00	6.25	7.50	10.00	12.50
9,000	0.25	0.45	0.65	0.90	1.10	1.65	2.20	2.80	3.30	4.40	5.50	6.60	8.80	11.00
10,000	0.20	0.40	0.60	0.80	1.00	1.50	2.00	2.50	3.00	4.00	5.00	6.00	8.00	10.00
15,000	0.15	0.25	0.40	0.55	0.65	1.00	1.35	1.65	2.00	2.65	3.35	4.00	5.30	6.50
20,000	0.10	0.20	0.30	0.40	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00	5.00
30,000	0.10	0.15	0.20	0.25	0.35	0.50	0.70	0.85	1.05	1.40	1.75	2.10	2.80	3.50
40,000	0.05	0.10	0.15	0.20	0.25	0.40	0.50	0.65	0.75	1.00	1.25	1.50	2.00	2.50
50,000	0.04	0.08	0.12	0.16	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.20	1.60	2.00
60,000	0.04	0.07	0.10	0.14	0.17	0.25	0.35	0.40	0.50	0.65	0.85	1.00	1.35	1.70
70,000	0.03	0.06	0.09	0.12	0.15	0.22	0.28	0.36	0.43	0.60	0.75	0.90	1.20	1.50
80,000	0.03	0.05	0.08	0.10	0.13	0.19	0.25	0.32	0.38	0.50	0.63	0.78	1.04	1.30
90,000	0.03	0.05	0.07	0.09	0.11	0.17	0.22	0.28	0.34	0.45	0.56	0.67	0.89	1.10
100,000	0.02	0.04	0.06	0.08	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00
200,000	0.01	0.02	0.03	0.04	0.05	0.08	0.10	0.13	0.15	0.20	0.25	0.30	0.40	0.50
300,000	0.01	0.02	0.02	0.03	0.04	0.05	0.08	0.09	0.12	0.14	0.16	0.20	0.27	0.36
400,000	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.07	0.08	0.10	0.13	0.15	0.20	0.30
500,000	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.10	0.12	0.16	0.20

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MACHINERY

DESIGN — CONSTRUCTION — OPERATION

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One Hundred per cent Return Every Seventy-two Days

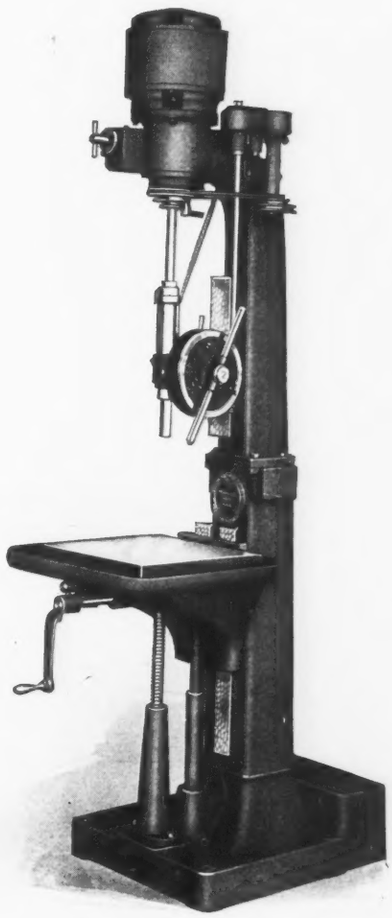
If you are looking for a safe and profitable investment, possibly one may be found right in your own plant. Even in the best equipped shops there are almost always opportunities to use better methods for some operations, and in most others possibilities always exist for increased profits through decreased production costs.

Ten per cent return on a safe investment is difficult to find, but here is one of many plant investments that pay better:—In machining a differential housing, an automobile manufacturer found that a new modern turret lathe with specially designed tool equipment increased his production over five times as compared with the methods superseded. The operations previously performed in 45 minutes, floor-to-floor, are now performed in 7½ minutes. The saving in cost of production is 98 cents per differential housing, or over $60 in a nine-hour day. The new equipment paid for itself in 72 working days; and every 72 days, while in operation, it turns in the equivalent of its own cost as profit.

We do not mention the above example as one that occurs frequently; but if you can save from 10 to 50 per cent a year on a good plant investment, it is worth considering.

Put Them Anywhere

Motor Spindle Drills



When you buy a Motor Spindle Drill you do not have to consider how you are going to drive it as there is only the need to bring the wires of your power line to the machine and it is ready to operate.

They are equipped with Multi-Speed Alternating Current Motors, specially designed for the duty, making it possible to change speeds instantly, thereby providing an efficient and flexible drive.

The control of the four motor speeds is within easy reach of the operator through a Drum Type Controller, making it possible to change speeds instantly.

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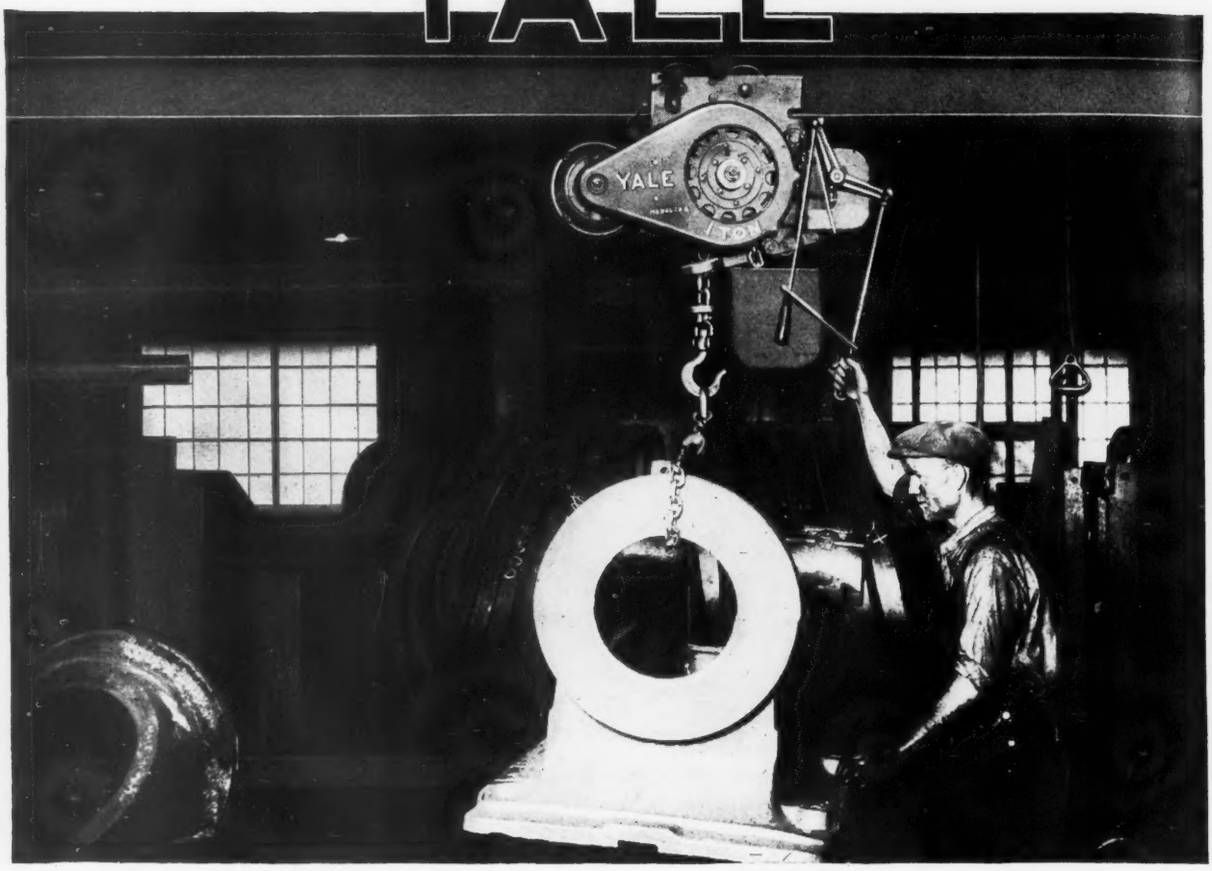

Yale Electric Hoists are
SAFE, ECONOMICAL and EXPEDITIOUS

The Yale Model 20B Ball Bearing Electric Chain Hoist is an ideal piece of equipment for handling heavy castings, where care and facility are essential.

It is here shown handling the heavy parts in a prominent gas engine plant. The smooth and positive action gives the operator greater ease in placing the load and the ball bearing load sheave and line of steel from trolley to hook make it the safest, most compact and most efficient hoist on the market.

Yale Model 20B Ball Bearing Electric Chain Hoists range from 1/4 to 2-ton capacity. The latest design embodies such features as ball bearing load sheave, close headroom, long lift, higher speed, automatic top and bottom limit stops, and greater over-all strength. These hoists have very unusual factors of safety in the strength of the load supporting members and are designed to withstand shock loads so common to this class of equipment. All suspension members of the Yale Electric Chain Hoist are made of the highest quality steel.

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The beauty of a machine tool might not at first thought appear to be an essential quality. But all mechanical progress leads toward greater simplicity and towards a clean-cut business-like appearance. Compare the automobiles of today with those of ten years ago, and you feel that efficiency does express itself in good looks.

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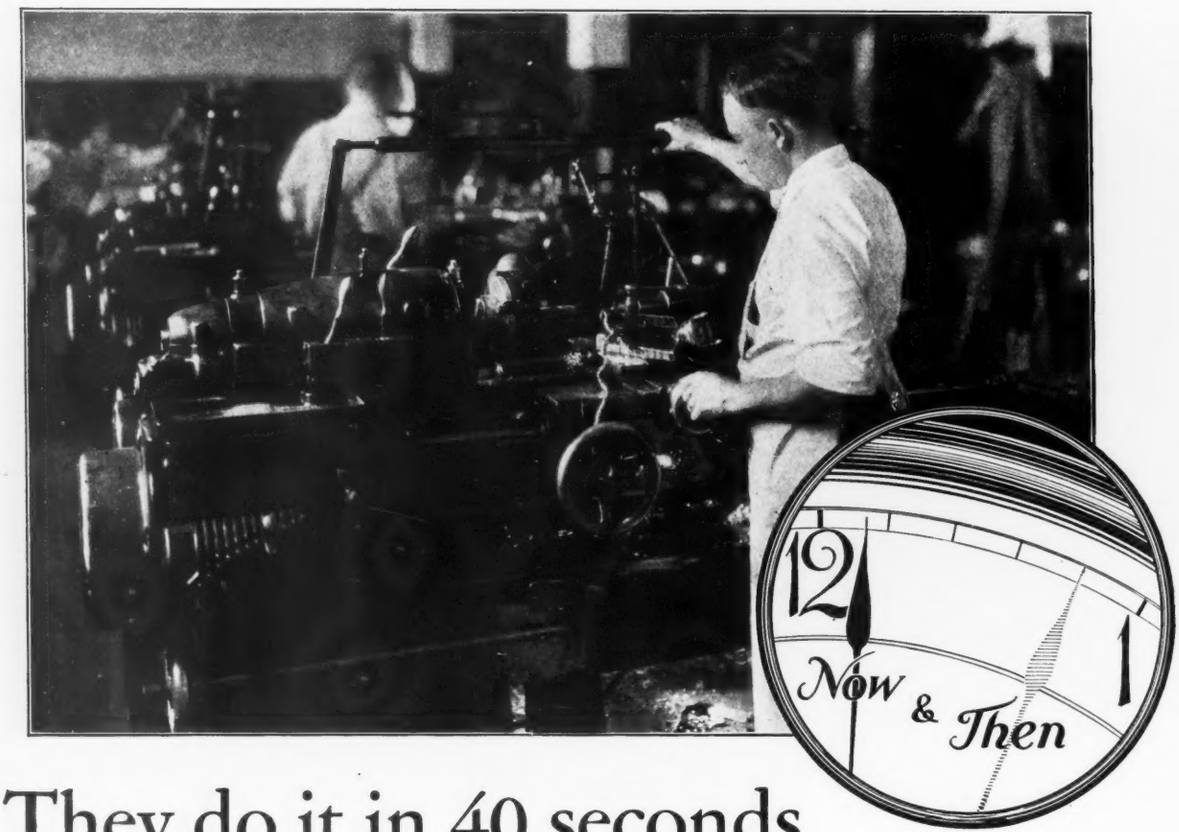


They do it in 40 seconds . . they used to take 4 minutes

THE Sun Tube Corporation bought P&W Model B lathes.

Here is an example of what these lathes do for them. Extrusion punches, 7" long are rough-turned from 1 3-8" diameter to 1.015 inches in 40 seconds. Formerly it took 4 minutes for this work.

On the same lathe, they ream pin holes that must be absolutely air-tight and tin-tight under 100 tons pressure with a minimum of lapping. They form-ream extrusion dies up to 2" diameter, cutting a feather chip and saving much polishing and cutting time.

By rough turning punches without a finishing cut they fit cross drilling jigs—saving one entire operation.

The story of P & W Model B Lathes in the Sun Tube Corporation's plant is typical of the great savings to be made and the improved quality obtainable in the product.

Mr. J. J. Lynch, President of the Sun Tube Corporation is always glad to welcome visitors to their plant, where they may see these most modern lathes making tooth-paste and other tubes in the most modern way.

Write to us for a full description of the Model B Lathes.

PRATT & WHITNEY CO., *Hartford, Connecticut*

Division NILES-BEMENT-POND COMPANY

PRATT & WHITNEY

A man came to 47th Street . . .

HE had some maps and blueprints, some delicate measuring instruments and a small drill. After some study he marked several places with chalk and his assistant drilled a few small holes in the asphalt surface of the street. Then they went away.

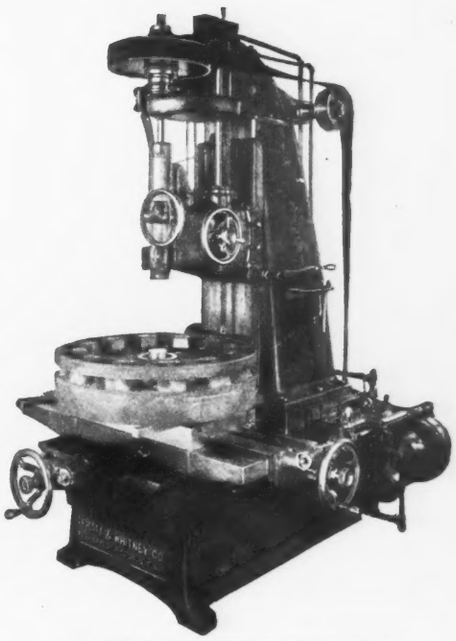
The next day, a gang of laborers came along and dug a big hole exposing some iron pipes. The first man's job was to *locate the hole accurately.* Any man with strength enough to use a shovel could dig the hole once it was located.

Any vertical borer can bore a hole

But we know of no other Vertical Borer made here or abroad that will locate a hole (to ten-thousandths of an inch) more quickly and easily than the Pratt & Whitney Jig Borer.

It is a marvel of precision. So accurate is it that many of the companies using it on work to be sent to others, have done away with inspection of the finished job. The Jig Borer self-checks its own work.

In addition, the Jig Borer is a powerful, rigid machine that eats up the work so that we have actual records of jobs done in one-fourth of the time taken by other borers.



PRATT & WHITNEY JIG BORER

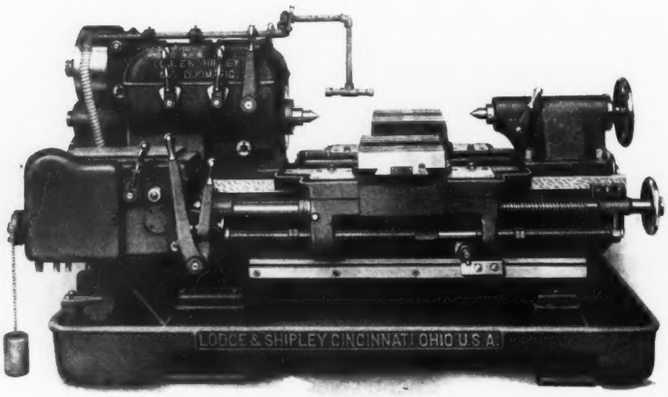
WRITE *to us for the fascinating story of what this machine is doing. Let us show you what it could do for you.*

PRATT & WHITNEY CO., *Hartford, Connecticut*

Division NILES-BEMENT-POND COMPANY

PRATT & WHITNEY

Speaking of p
These machines have s



The Lodge & Shipley DUOMATIC

This machine is new—unique! It embodies features that are distinctive—features that have won over to it a large following.

The DUOMATIC is making good! And why not? It represents the culmination of 33 years specialism at building lathes. Only the finest materials and workmanship enter into its construction. The high quality of materials and workmanship in it justify a correspondingly higher price than many other makes. The significant feature of this is that for the second installation the customer's question is not "How much?" but "How soon can you ship?"

It will be to your advantage to send for the booklets sho

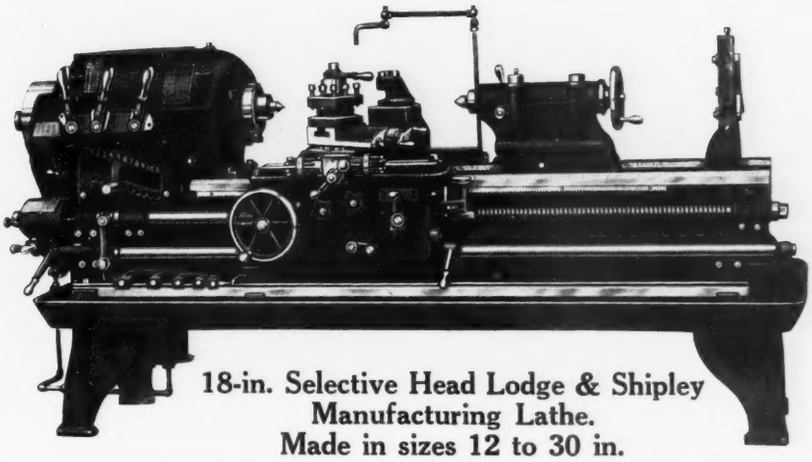
Send today for t

Get the fa

The Lodge & Shipley M

Cincinnati, O

production
set new marks



18-in. Selective Head Lodge & Shipley Manufacturing Lathe. Made in sizes 12 to 30 in.

The Lodge & Shipley Manufacturing Lathe

The Manufacturing Lathe is an ideal investment—*It can be kept busy!* It can instantly be converted from a general purpose tool to a quantity manufacturing machine. Not only does it effect a time-saving of 25 to 75 per cent as compared to the engine lathe but a higher standard of accuracy is maintained.

Small lots of parts that do not justify the use of an automatic can be done on the Manufacturing Lathe in record time. Between lots the lathe can be kept busy on single one-piece jobs. In short, this machine is an ideal medium between an engine lathe and an automatic. Possibly somewhere in your shop you have use for just such a lathe as this.

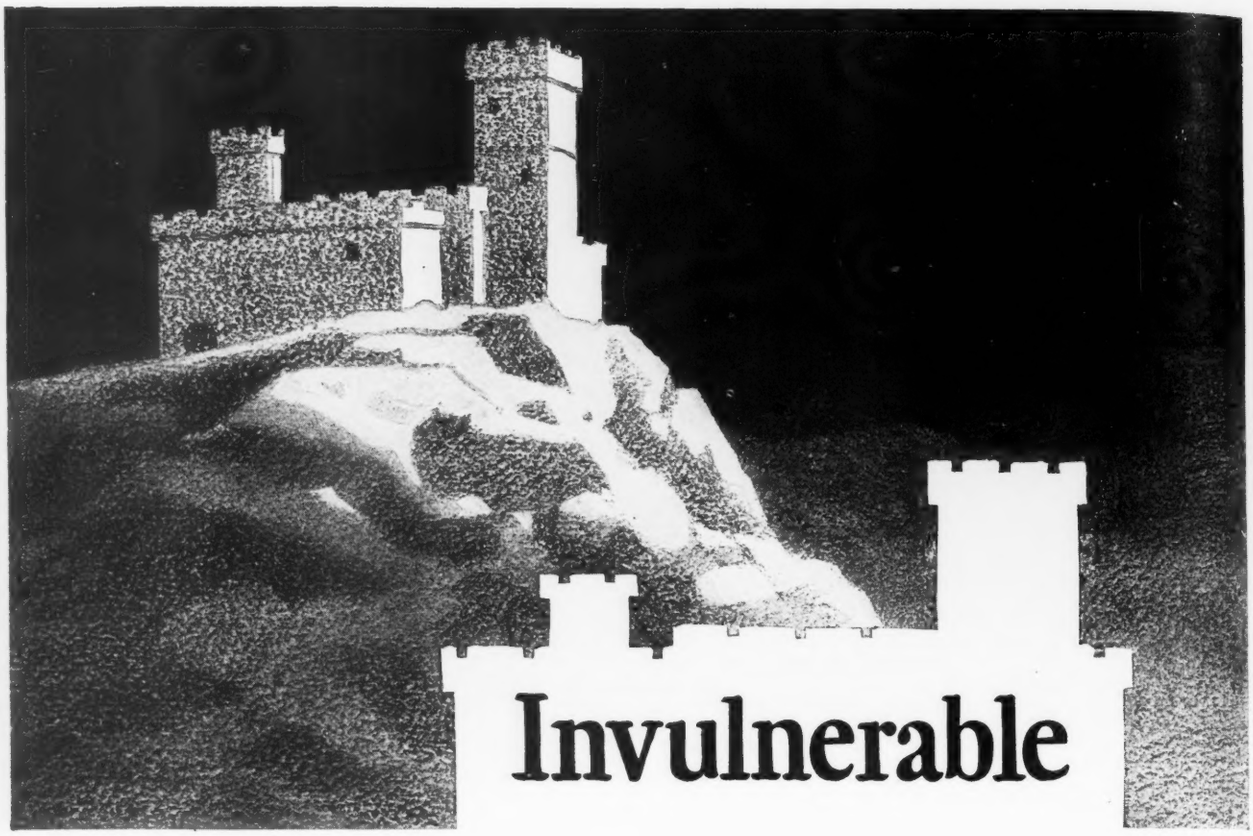
shown here. They give complete information.

these booklets

facts

Machine Tool Company

Ohio



Invulnerable

THE STAUNCH fortresses of medieval times successfully repelled the attacks of hostile forces. They were impregnable, invulnerable. To-day industrial metals are called upon to resist the continuous assaults of corrosion, and their resistance to corrosion is an important criterion of industrial value.

Haynes Stellite, thoroughly tested in both laboratory and plant, has taken its place as a corrosion resistant metal. Particularly notable is its complete inertness to all strengths of nitric acid. It is not affected by any common chemical and only hydrochloric, hydrofluoric and concentrated boiling sulphuric acids attack it.

Our booklet, "The Properties of Haynes Stellite," discusses the chemical and physical properties of the metal and its many varied uses. It might show you where the metal can effect an economy in your business.

Properties of
HAYNES STELLITE

1. It is an intrinsically hard cast metal.
2. It requires no heat treatment.
3. It has temper that is inherent and permanent.
4. It resists abrasion better than any other metal.
5. It is not affected by heat up to 1800° F.
6. It is tougher at red heat than when it is cold.
7. It is highly resistant to almost all acids and chemical compounds.
8. It has the untarnishable qualities of gold and platinum.
9. It takes a high silver white polish and retains it.
10. It is non-magnetic and, except in the molten state, does not adhere to other metals.

HAYNES STELLITE COMPANY
KOKOMO, INDIANA

District Sales Offices: Carbide and Carbon Building, 30 East 42d Street, New York
Peoples Gas Bldg., Chicago Keith Building, Cleveland General Motors Bldg., Detroit
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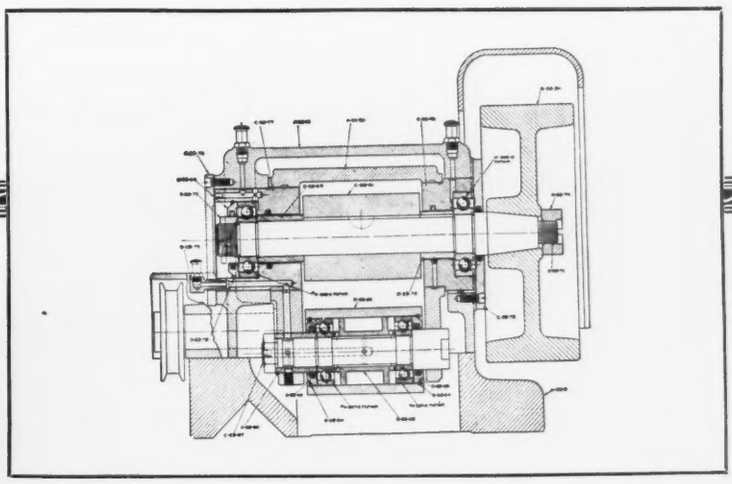
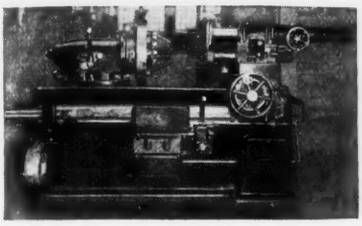
HAYNES STELLITE

Longitudinal sectional elevation of main idler housing, showing Fafnir Ball Bearings on spindle jack shaft and idler shaft.





Front view of the "HYDROIL" No. 28 Internal Grinding Machine, heavy duty, for big bore grinding operations, manufactured by the Greenfield Tap and Die Corp., Greenfield, Mass., and equipped throughout with Fafnir Ball Bearings.

Fafnirs throughout—on largest chucking internal grinder built!

Note the rugged design and construction of this new GTD No. 28 "Hydroil" Internal Grinder. The largest chucking internal built! Just the kind of a heavy duty machine you would select for big bore grinding operations.

Fafnir Ball Bearings are used throughout,—on

main drive shaft; main idler jack shaft; work head shafts main idler shaft; flexible idler spindle; wheel head shafts

This preference for Fafnirs is typical of the ever-growing practice among machine builders to insist on Fafnir Ball Bearings exclusively wherever longer bearing life, less attention, maintenance of exacting spindle alignment, accurate work, and greater production are wanted.

The following list is typical of the large number of machines in which Fafnir Bearings are being successfully used:

Adding, weighing and recording machinery; agricultural machinery; bottling machinery; camera machinery; candy machinery; cement mill machinery; cloth cutting machinery; compressors; conveyors; cranes; drilling machinery; electric motors and generators; electric and pneumatic hoists; elevators and elevating machinery; engines (steam and combustion); fans and blowers; farm and industrial lighting plants; floor scrubbers; flour mill machinery; glass machinery; grinding machinery; gyroscopes; hammer mill machinery; industrial trucks; lawn mowers; machine tools; mine cars; mining locomotives; mining machinery; oil burners; oil mill machinery; oil well machinery; paper machinery; pneumatic and electric tools; printing machinery; pumps; railway headlights and car lighting generators; refrigerating machinery; rubber machinery; sewing machines; shoe machinery; speed reducers; steel mill machinery; sugar machinery; surfacing machines; switch and signal machinery; textile machinery; vacuum cleaners; variable speed transmissions; washing machines; wire-drawing machinery; woodworking machinery.

THE FAFNIR BEARING COMPANY

Makers of high grade ball bearings—the most complete line of types and sizes in America.

NEW BRITAIN, CONN.

Chicago Newark Cleveland Detroit

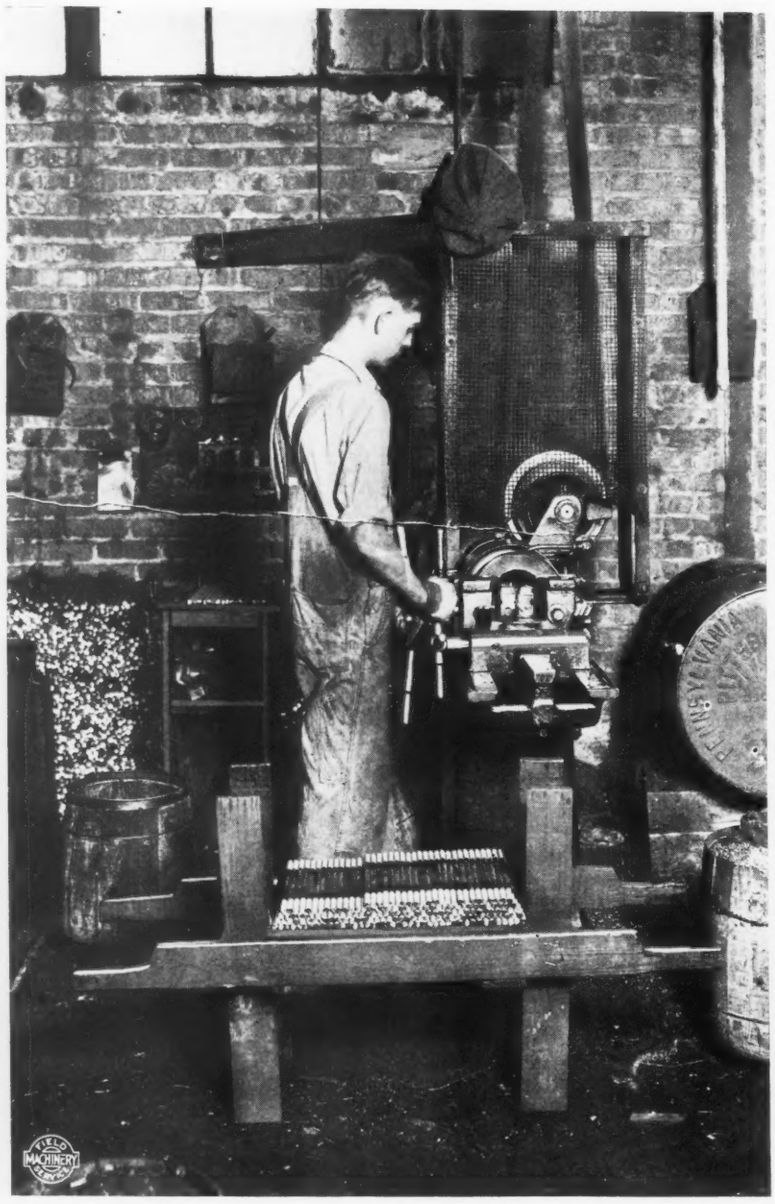
Let us place your name on our mailing list to receive gratis our monthly publication "The Dragon." Every issue describes a novel application of ball bearings that is certain to interest you.

FAFNIR
BALL BEARINGS

THE MOST COMPLETE LINE OF TYPES AND SIZES IN AMERICA

24 Hours Continuous Service

Landis Threading Machine



This Landis Belt Driven Threading Machine at the Lee C. Moore Company, Tulsa, Oklahoma, operated for eight years—*the first two at 24 hours per day*—without even renewing the bearings, is an example of the efficiency of Landis design and construction, of Landis standards for machine service.

Accurate threads, rapid production and the capacity to meet demands for uninterrupted service makes a Landis installation a permanent satisfaction to the modern manufacturer.

Landis Threading Machines equipped with the well known Landis Rotary Die Heads and the new Lanco Heads are threading bolts and nuts in progressive plants in all parts of the globe. Let us give you data on Landis Threading Operations and Production costs.

LANDIS TRADE — MARK

LANDIS MACHINE COMPANY, Inc.

Detroit Office: 5928 Second Boulevard

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; R. B. Whitacre & Company, St Paul, Minn.; Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wright & Co., New Orleans, La.; Jos. T. Ryerson & Sons, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hard-

Threaded in Ten Seconds

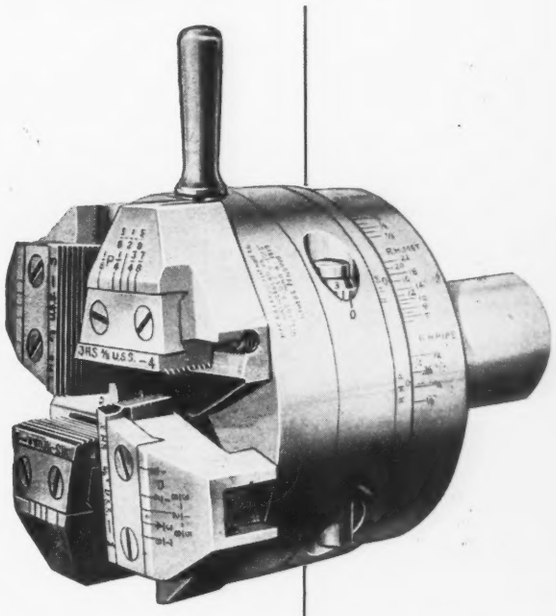
with the Land-Matic Die Head

Studs 3″ long over all, ¾″ diameter, threaded for 1-1/16″ at one end, 1⅛″ at the other, 8 threads per inch, time, 10 seconds—both ends—floor to floor; work put through in lots of 50 or 100 pieces.

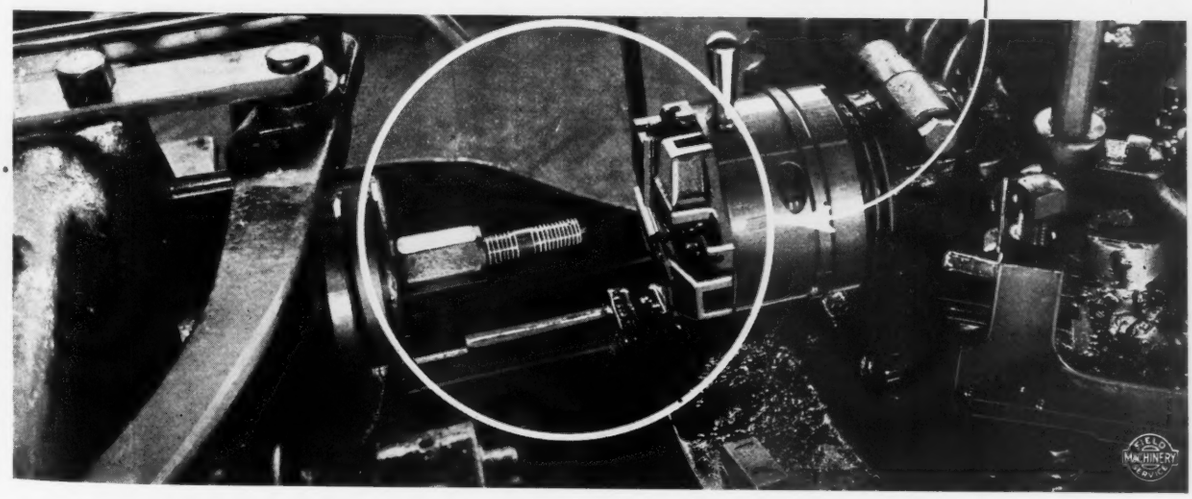
Fast, accurate work, wide range and durability—one set of Landis Chasers positively outlasts ten to twenty sets of other types—account for the popularity of these tools in big modern plants.

Land-Matic Heads enable turret lathe threading to be done with maximum efficiency and economy on all classes of work.

Land-Matic Heads are used on turret lathes and hand operated screw machines. You are behind the times if your turret lathe is not Land-Matic equipped.



LANDIS TRADE MARK

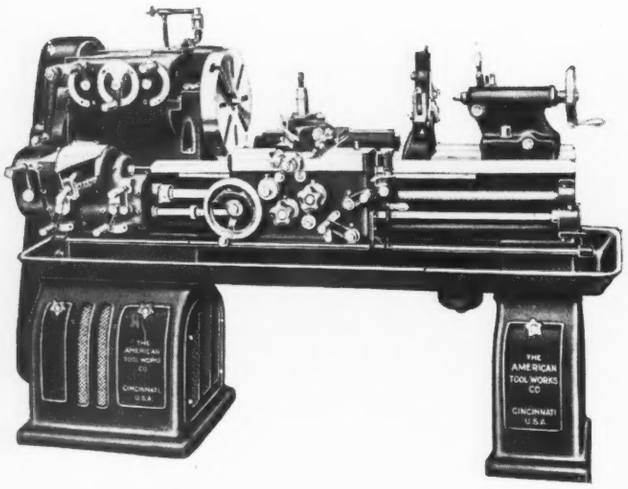


Waynesboro, Pennsylvania, U. S. A.

ware Co., Salt Lake City, Utah; Herberts Machinery & Supply Co., San Francisco, Calif.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Harry M. Euler Co., Portland, Ore.; Hallidie Machinery Co., Seattle, Wash.; Hallidie Co., Spokane, Wash.

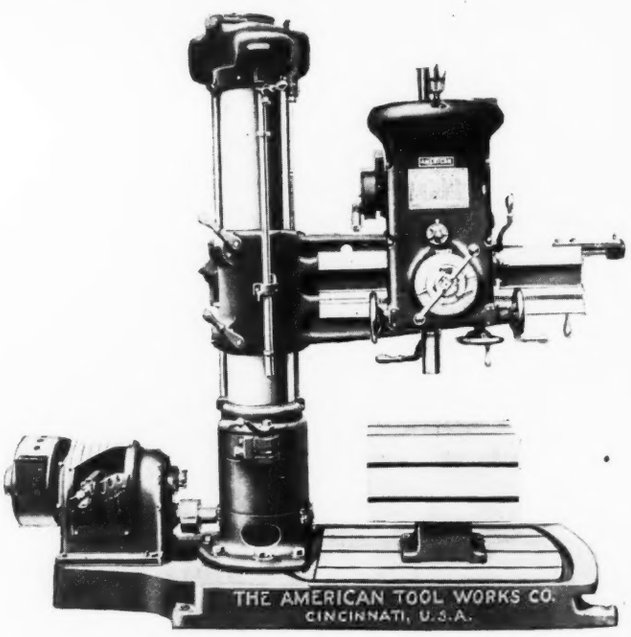
CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Toronto and Montreal.

FOREIGN REPRESENTATIVES: Benson Brothers, Ltd., Sydney; Schuchardt & Schutte, Berlin, Vienna, Prague, Warsaw; R. S. Stokvis & Zonen, Rotterdam, Brussels, Soerabaya; M. Almeida & Cia, Sao Paulo, Rio de Janeiro; Alfred Herbert, Ltd., Coventry, Calcutta, Osaka; Burton Fils, Paris; D. Drury & Company, Johannesburg.



Lathes Shapers Radials

American



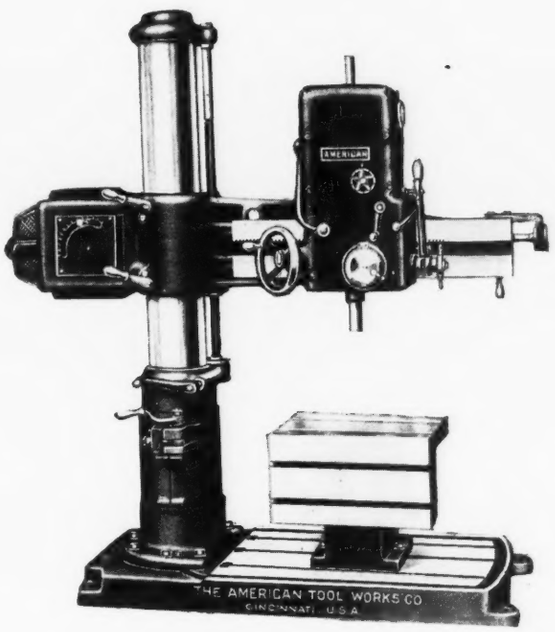
Every manufacturer needs them if he is to meet the keen competition of modern industry—and in every line production possibilities (manufacturing costs) are controlled by the efficiency of his shop equipment.

"American" Lathes, Shapers, Radials are "keystone equipment" for modern metal working plants. Complete production efficiency (rapid production, low costs), in the operations performed on these essential machines is a good beginning for profitable manufacturing.

CINCINNATI
MAKES MORE MACHINE TOOLS, IN LARGER VARIETY, THAN ANY OTHER CITY IN THE WORLD
TO SEE ANY UP-TO-DATE MACHINE TOOL COME TO
CINCINNATI

THE AMERICAN TOOL WORKS

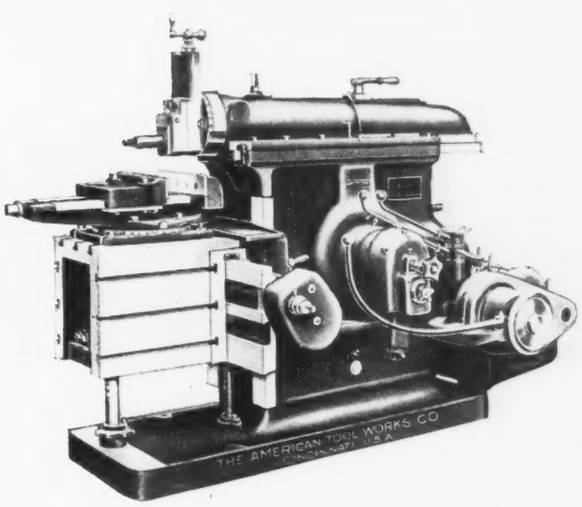
Profitable Producers



"American" machine tools are the results of careful study of the demands made on modern equipment in every line of work. Designed and built by men who know the conditions and requirements of modern work; simplified, strengthened, made more powerful than the usual machines of their class, they meet the needs of the producer in a wholly satisfactory, wholly profitable way.

American

Standard models (with interchangeable parts) for standard machining operations; special designs, with special developments and attachments adapted to the requirements of every metal working industry. See catalog M—and put your production problems up to "American" engineers.



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Jones & Lamson

Hartness Flat Turret Lathe
Fay Automatic Lathe
Hartness Double Spindle Flat Turret Lathe

Springfield, Ve

J&L
TRADE MARK REGISTERED U.S.A.
JONES & LAMSON

The Answer Is Found

to many difficult gaging problems by the use of magnified visual inspection.

The J. & L. Hartness Comparator has made possible economic manufacture of interchangeable screw threads.

It is performing this same service for many other articles of odd shapes which are manufactured in quantity.

The knitting needle shown on the J. & L. Comparator chart must be held to a tolerance of .001 on the dimension indicated.

To gage this needle mechanically would be difficult. Magnified fifty times on the J. & L. Comparator chart, gaging becomes a simple matter.

The parts shown are among those which are gaged on the J. & L. Hartness Comparator.

Machine Company

Vermont, U. S. A.

Hartness Automatic Die
Flanders Ground Tap
Hartness Screw Thread Comparator

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BE SURE AND SEE

THE LE BLOND No. 16 HEAVY DUTY AUTOMATIC LATHE

IN OPERATION

SPACES 314-315

NATIONAL STEEL AND MACHINE TOOL EXPOSITION

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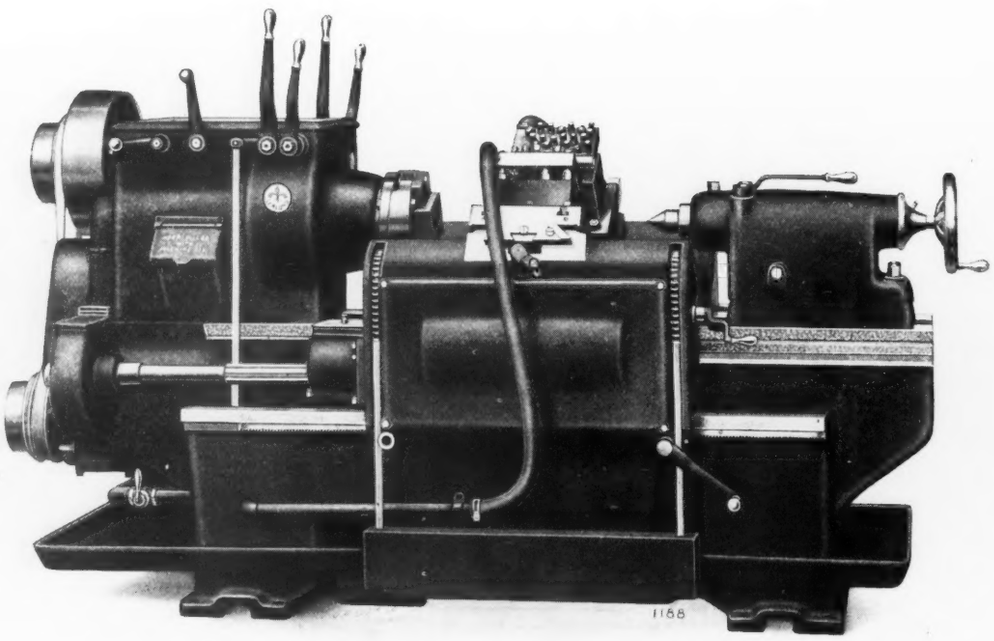


This machine is particularly adapted to the economic production of Cluster Gears, Steering Knuckles, Ring Bevels, Main Drive Pinions, Center Bearings, Flange and Stub Ends of Crankshafts, also Short Shafts and the heavier Automobile and Truck Parts.

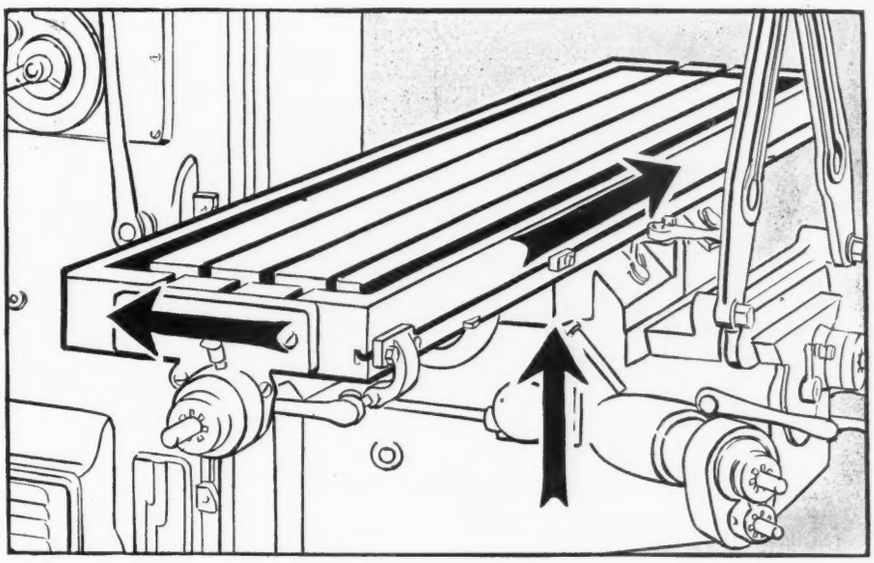
BE SURE AND SEE IT

CINCINNATI MAKES MORE MACHINE TOOLS IN LARGER VARIETY THAN ANY OTHER CITY IN THE WORLD TO SEE ANY UP-TO-DATE MACHINE TOOL COME TO CINCINNATI

The R. K. LeBlond Machine Tool Co.
Cincinnati, Ohio

CINCINNATI MAKES MORE MACHINE TOOLS IN LARGER VARIETY THAN ANY OTHER CITY IN THE WORLD TO SEE ANY UP-TO-DATE MACHINE TOOL COME TO CINCINNATI

IF IT CAN BE MILLED — MILL IT FASTER!



Power Rapid Traverse in 3 Directions

on K & T's New No. 4 Milling Machine

In or Out
Up or Down
Left or Right

THE prevailing style in machine tool design calls for Power Rapid Traverse. You find it on the new planers—boring mills—lathes—in fact, it is now considered as a machine shop necessity.

Power Rapid Traverse has long been applied to milling machine tables. But now Kearney & Trecker have gone forward another step. On their big new No. 4 milling machine, Power Rapid Traverse is provided not only for the table—but for the saddle and knee as well.

The rates of travel are very fast. The table can be quick traversed left or right at the rate of 150″ per minute—in or out, at 70″ per minute—and up or down at the rate of 50″ per minute. All movements are conveniently controlled from the front of the machine. Power Rapid Traverse in all directions is a big factor in the ease with which the milling machine may be either set up or operated. Particularly is this true when raising the table carrying a heavy work piece.

Next to safety, the biggest production factor is ease of operation. Power Rapid Traverse in 3 directions means that the operator will get more work out of a Kearney & Trecker No. 4 Milling Machine—and with less physical effort on his part.

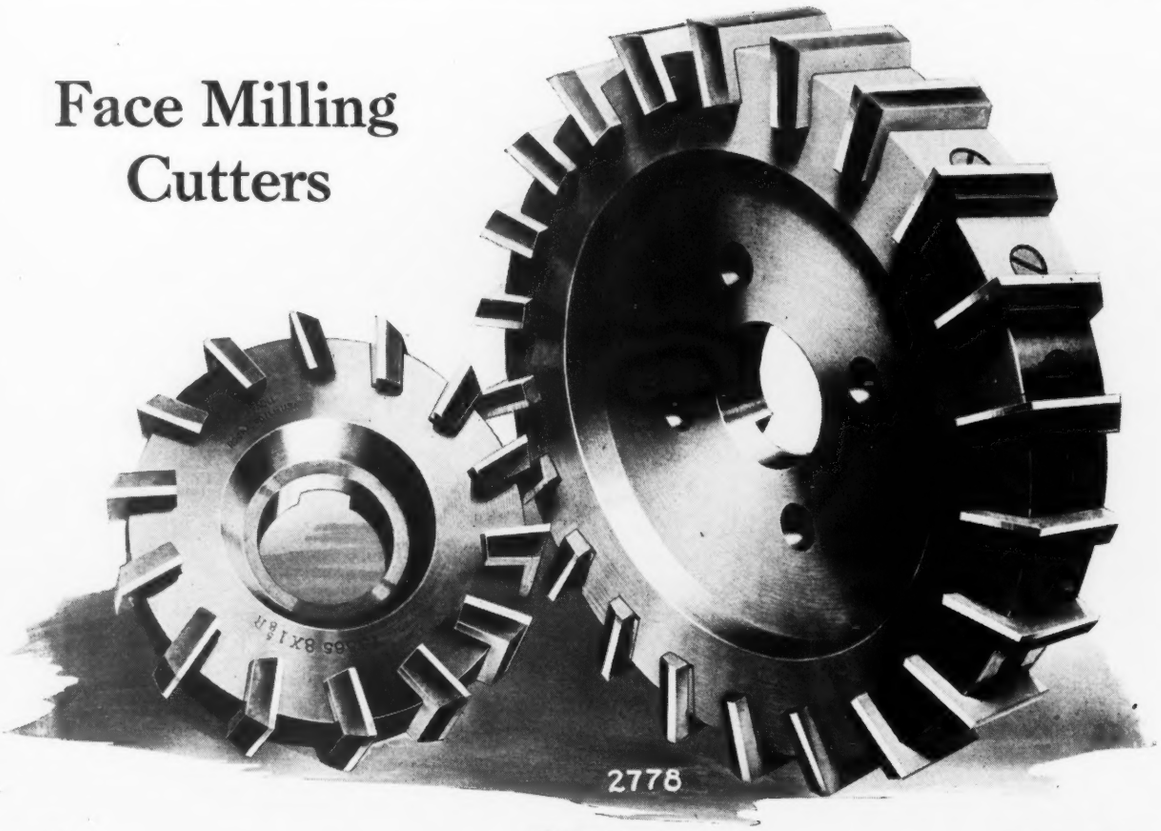
This big No 4 Miller with its many productive features is fully described in a new illustrated bulletin. Have you a copy?

KEARNEY & TRECKER CORPORATION
Milwaukee Wisconsin

MILWAUKEE MILLING MACHINES

KEARNEY & TRECKER

Face Milling Cutters



TYPE X

Ingersoll

THE Ingersoll Type "X" Inserted Tooth Cutter is a heavy duty cutter for rough or finish milling in iron or steel. It is particularly useful when the work calls for cutting on the face and periphery at once, milling into a sharp corner. This is one of the five standard types of Ingersoll inserted tooth cutters which are carried in stock at Rockford for immediate shipment.

The Type "X" housing is a hardened steel forging, with the high speed blades held in place by hardened wedges and locked by screws. This method of holding is simple and makes the resetting or replacing of blades easy, but at the same time, it holds them so firmly that a large proportion of the high speed steel may be used before the blades must be replaced.

Cutter Bulletin No. 44 describes our standard cutters, and many special types. We will gladly send it on request.

The Ingersoll Milling Machine Company

Milling Machines and Their Equipment

ROCKFORD, ILL.

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
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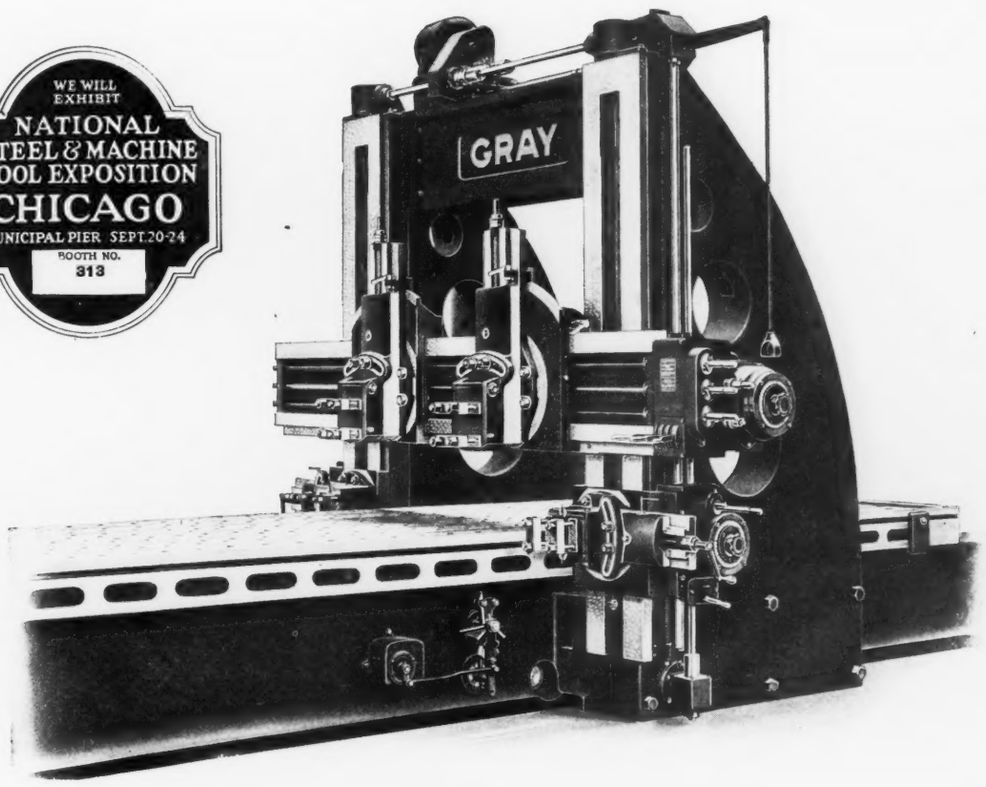
BOOTH NO. 313

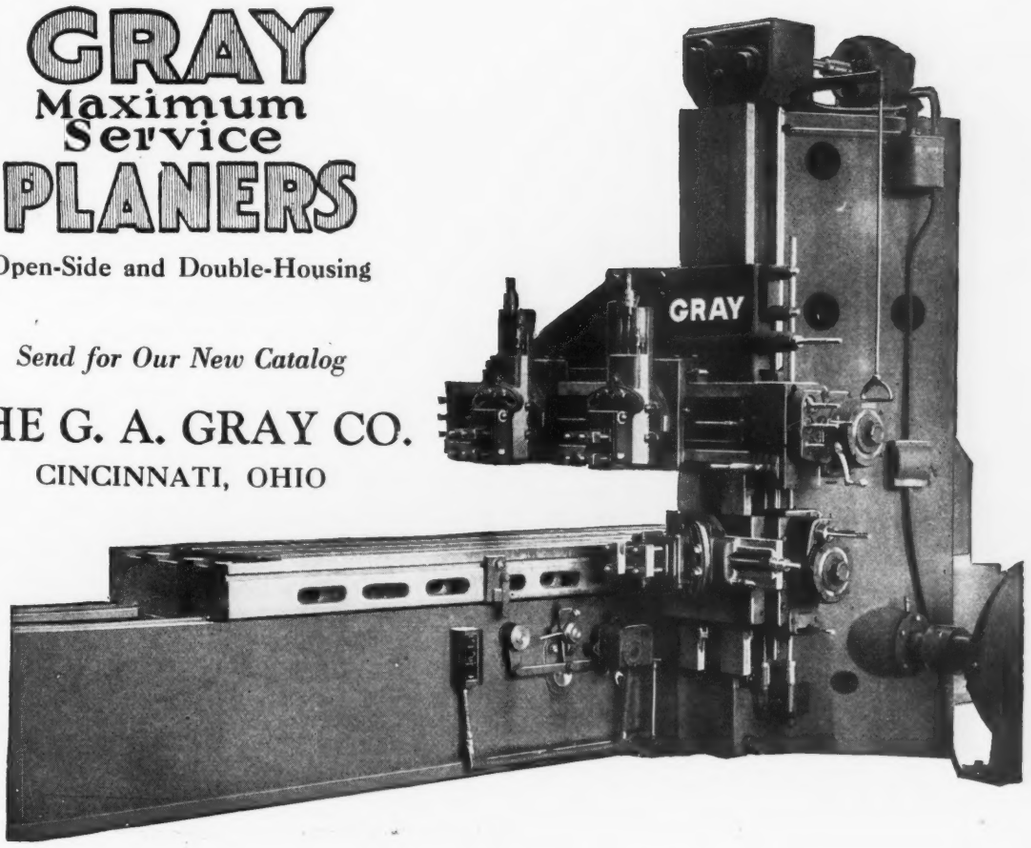


GRAY
Maximum Service
PLANERS

Open-Side and Double-Housing

Send for Our New Catalog

THE G. A. GRAY CO.
CINCINNATI, OHIO



BULLARD STILL LEADS IN M

When the job requires it,—heavy machining up to 64 in. swing, sturdy tool support, excessive power, quick and easy handling of the work with simple machine control and power helps for the operator,—there's one tool that answers your requirements with production and economy.

The Maxi-Mill offers extra features in design, construction and operation without proportional extra price. And the extra margin of economy keeps piling up profits long after the tool has paid for itself.

THE MAXI-MILL

N MODERN BORING MILLS

There are high grade materials, laboratory controlled and carefully selected for their particular service, used in construction.

Single Pulley drive with unit power and speed control handy to the operator.

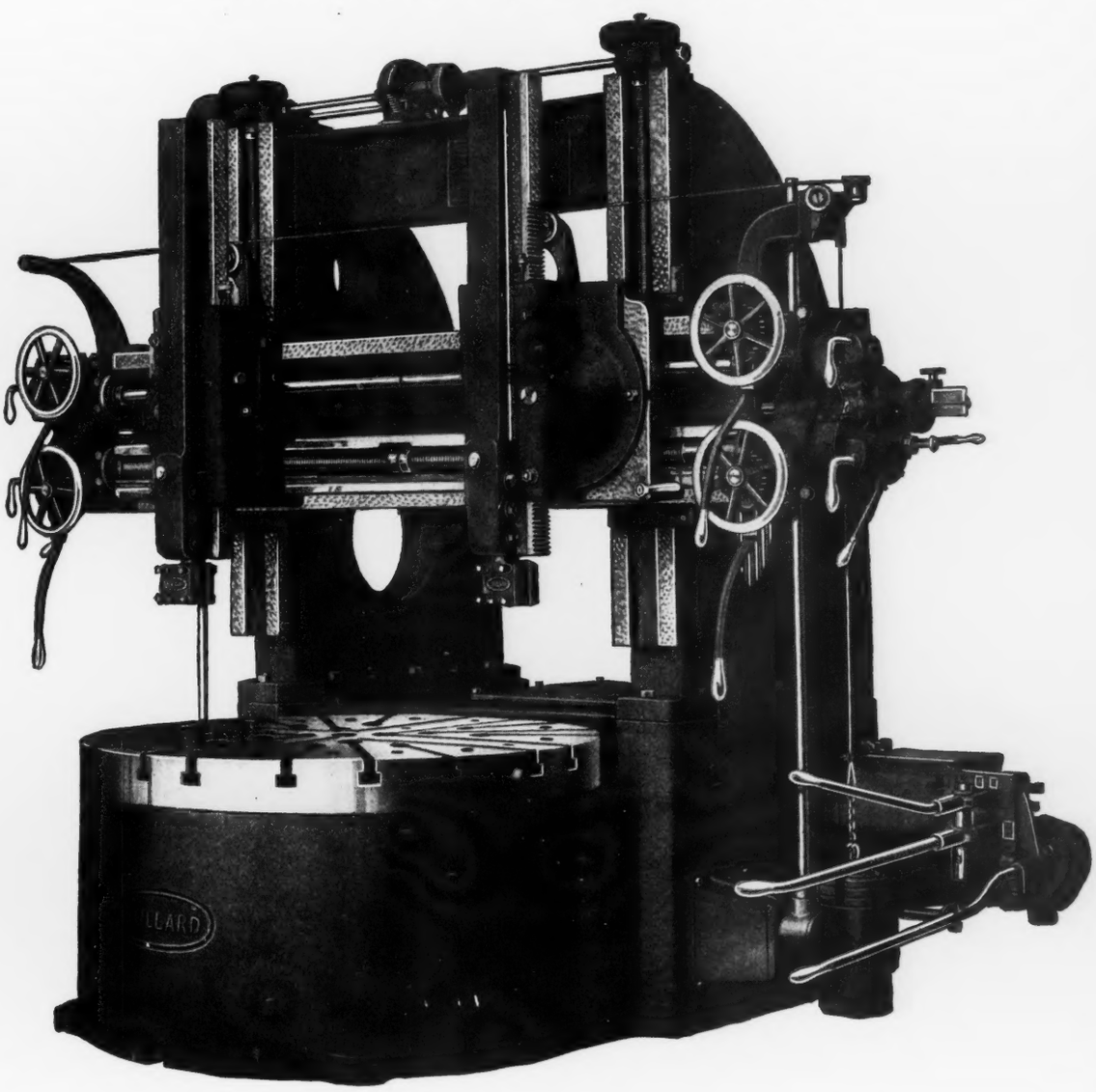
Quick change feed adjustment, wide range, positive, independent for each head with power rapid traverse to save time and energy.

Plus Continuous flow lubrication, broad bearings with adjustment by tapered gibs, graduated scales and micrometer dials, extension levers for heavy hand feed.

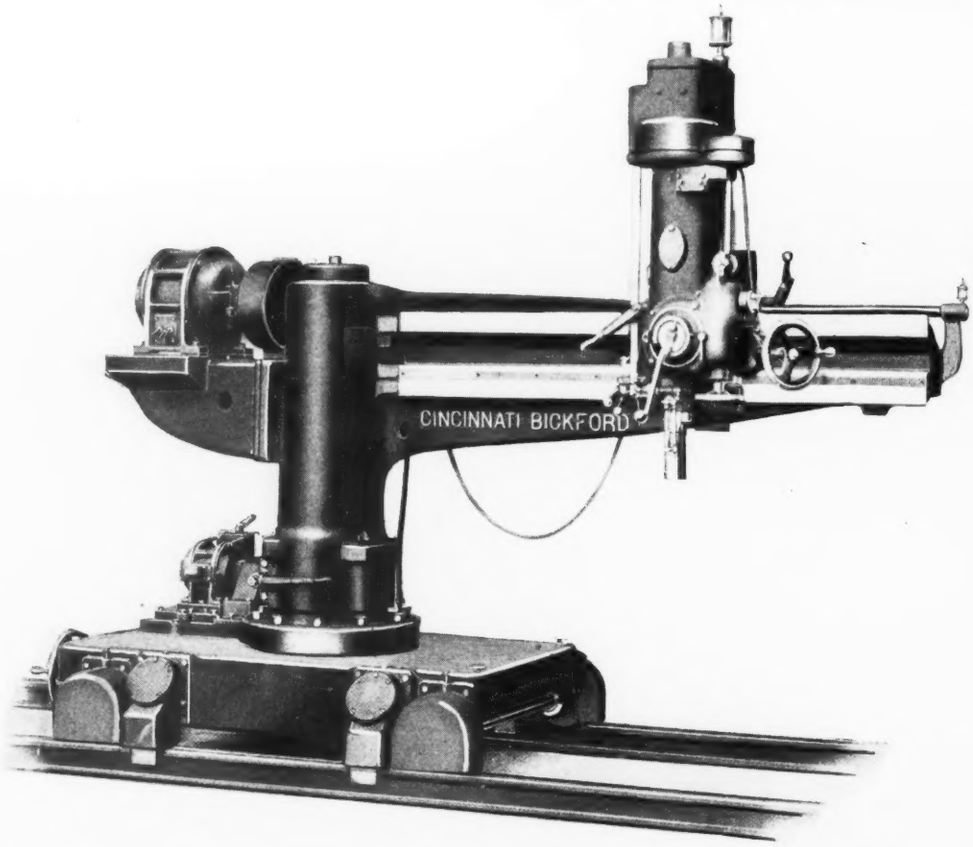
It's a modern mill measured by the latest shop requirements.

Built In

BRIDGEPORT, CONNECTICUT



A FEW NEW CHAPTERS IN HOLE M



EIGHT HUNDRED 11/16" DIAMETER HOLES PER HOUR IN ¼" PLATE is the daily performance of the CINCINNATI BICKFORD Heavy Type Plate and Rivet Hole Driller.

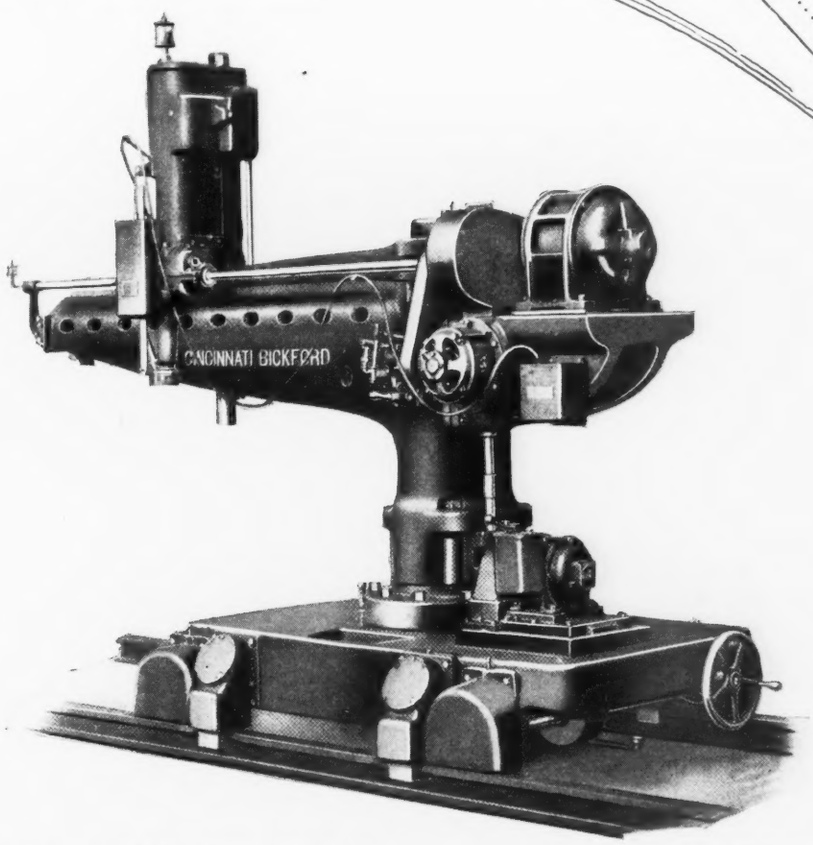
THIS MACHINE was especially designed for boiler, tank and structural shops. It offers a production on duplicate plates that is rarely exceeded except by multiple punching where the entire plate is punched at one stroke or where a spacing table is used.

The machine consists of a special type of radial drill, having the base mounted on wheels and arranged for traveling under its own power on a track parallel to a bench or trestle on which the plates are stacked.

The method consists of stacking as many plates as the length of the twist drill will permit. A plate from a previously drilled lot is used as a template. While one stack is being drilled another is being set up on the other end of the bench.

The CINCINNATI BICKFORD TOOL CO., O

MAKING HISTORY



The bench should be long enough to support two stacks, end to end, of the longest plates which are to be drilled. When one stack is finished the operator runs the machine under power to the other and continues drilling.

The economies resulting from the use of this equipment are at once evident. Only one man is required to operate the machine—helpers are not needed. The usual labor gang is only used to stack the plates on the bench prior to drilling and to remove those which have been drilled. Laying out of holes is practically eliminated, as a plate from a previously drilled lot serves as a template. Idle machine time is negligible, for it occurs only when the machine is traveling between the two stacks of plates.

In erecting, further economies are realized. Reaming is practically eliminated because the duplication of holes in the plates is perfect. Easier and better riveting results because the sides of the holes are straight and not tapered, as is the case in punched holes. Drill breakage rarely occurs because of the extreme rigidity of the machine, and the cost of drills for a given quantity of holes is considerably less than the cost of punches.

Cincinnati-Bickford Tool Company,
Oakley, Cincinnati, Ohio

Gentlemen:
I am interested in seeing all of this new book and ask you to mail me a copy at once.

Name .....
Company .....
City ..... State .....

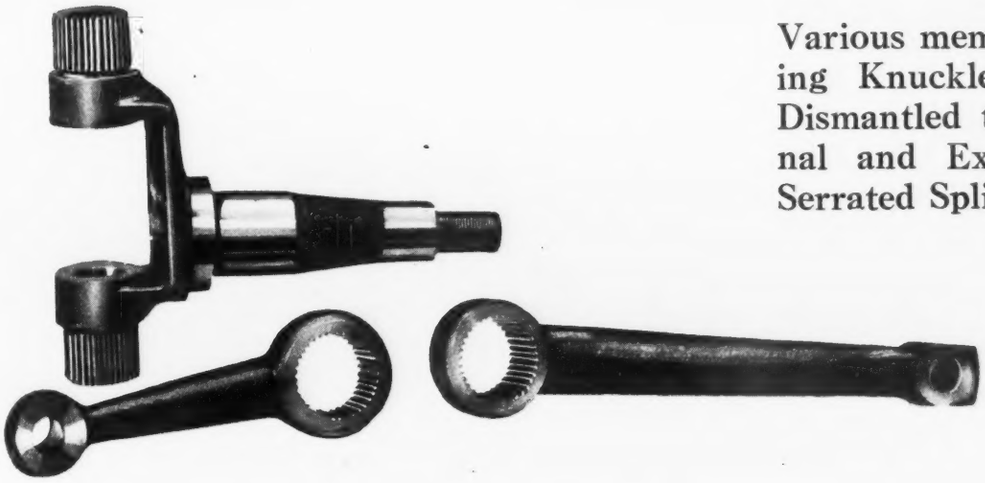
Oakley, Cincinnati, Ohio *founded 1874*

Steering Knuckle Assembly for a Truck Front Axle in which Taper Serrated Splines are used.

A New Application of The High-Speed Gear Shaper

THE High-speed Gear Shaper is not necessarily confined to the cutting of gear teeth, nor the generation of involute shapes, as the accompanying illustrations will show. The parts illustrated are members of a steering knuckle assembly for a truck, and the knuckle, proper, is provided with external taper splines on both ends. The mating arm members are provided with internal taper serrated splines corresponding to those on the knuckle.

Both Internal and External taper serrations are cut on the High-speed Gear Shaper.



Various members of Steering Knuckle Assembly—Dismantled to show Internal and External Taper Serrated Splines.

A slightly modified machine is required for this purpose—a taper raising block is placed between the base and bed of the machine, so that the cutter-spindle is set out of the parallel plane with relation to the axis of the work-spindle.

The work is handled in a rapid manner, and cut to a degree of accuracy that meets the most exacting requirements. Hence, an excellent fit is secured between the various members.

This is only one of several applications that have been recently accomplished on the High-speed Gear Shaper in the interests of better work at lower cost.

Let Us Help YOU.

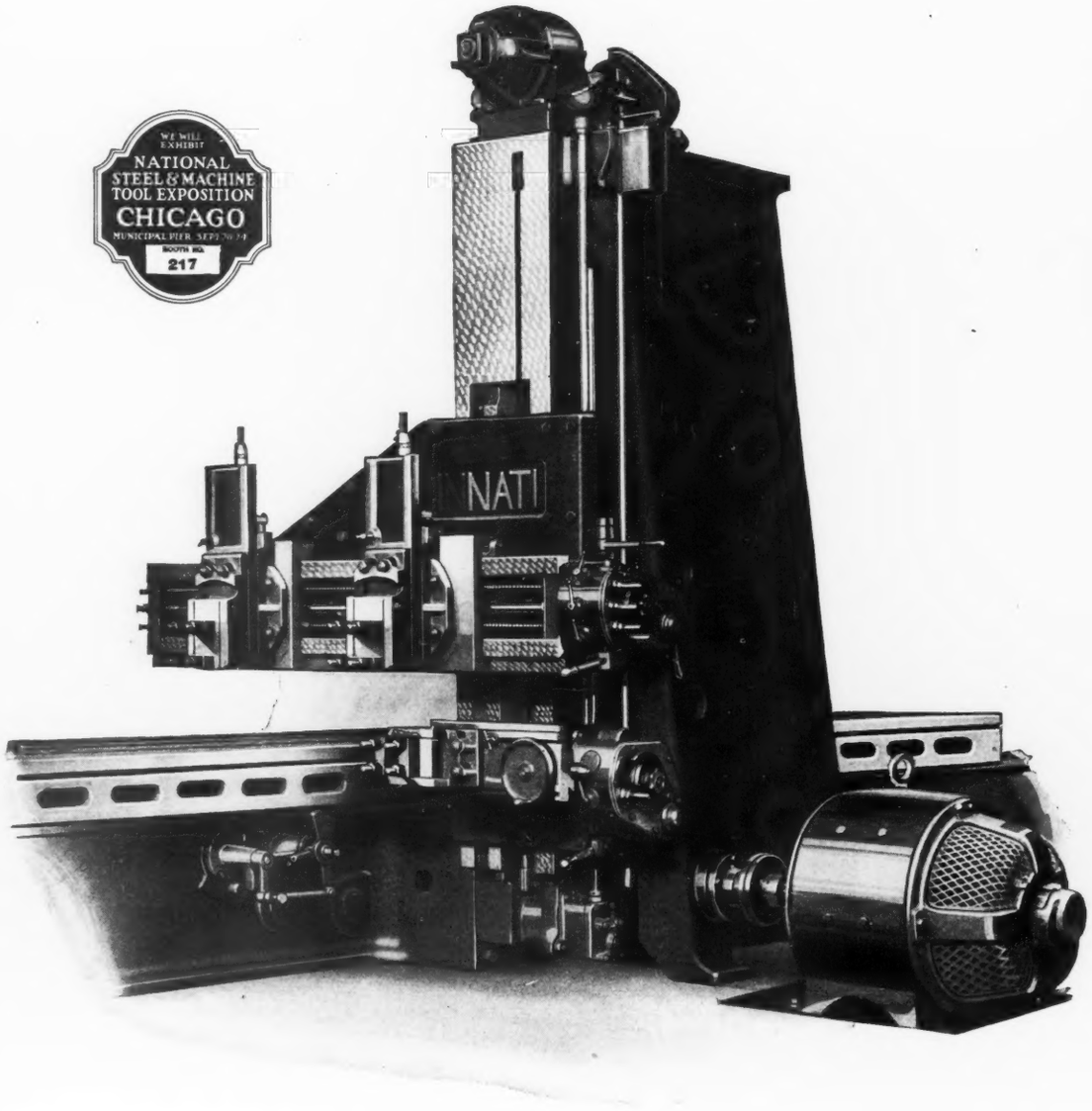
The Fellows Gear Shaper Company

Head Office and Works: 78 River Street, Springfield, Vermont
Branch Office: 651 Book Building, Detroit, Michigan

FOREIGN AGENTS—Alfred Herbert, Coventry, England—Great Britain. Alfred Herbert, Sydney—Australia; Societe Anonyme Alfred Herbert, Paris—France and Spain; Societa Anonima Italiana Alfred Herbert, Milan—Italy; Societe Anonyme Belge Alfred Herbert, Brussels—Belgium and Holland; Bohm & Bormann, Berlin—Germany, Czecho-Slovakia and Austria; Aktiebolaget A. Bonthron, Stockholm—Sweden, Finland and Norway; American Machinery Import Co., Zurich—Switzerland.

PACIFIC COAST REPRESENTATIVE—Louis G. Henes, San Francisco and Los Angeles—California, Arizona and Nevada.

A Good Investment

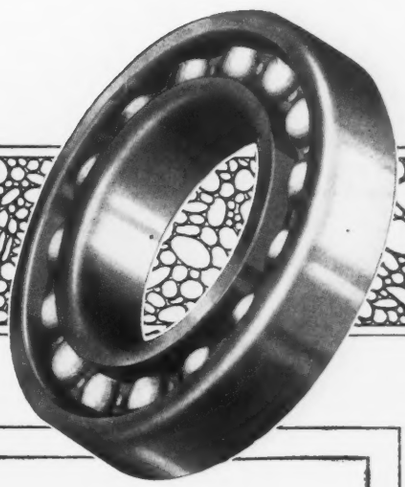


Cincinnati **HYPRO** will not cost more but will give more for every dollar invested. The large number of real operating and production features, accuracy and a production that will decrease cost.

Send your blue prints for estimates

THE CINCINNATI PLANER CO.

CINCINNATI, OHIO, U. S. A.



New Departure Quality Ball Bearings

Here's a Good Example of What They Will Do for You

One of the chief difficulties with plain bearings is the proper retention of oil as a lubricant in *vertical* shafts.

When centrifugals are used for laundry purposes, there is the added danger of soiling the material in the basket.

The use of New Departure Ball Bearings in both the centrifugal and electric motor, together with the use of grease as a lubricant, made this installation both more efficient and trouble proof.

The electric motor is mounted to swing into a horizontal position to allow removal of the basket. This change of position, perfectly safe with New Departures, might (if sleeve Bearings were used) allow oil to leak into the windings and cause short circuits and burn-outs.

Engineers and designers are offered a copy of "Ball Bearing Application" for their reference library—a loose leaf book of bearing applications to which new sheets are added monthly by the New Departure Engineering Department.

THE NEW DEPARTURE MFG. CO.

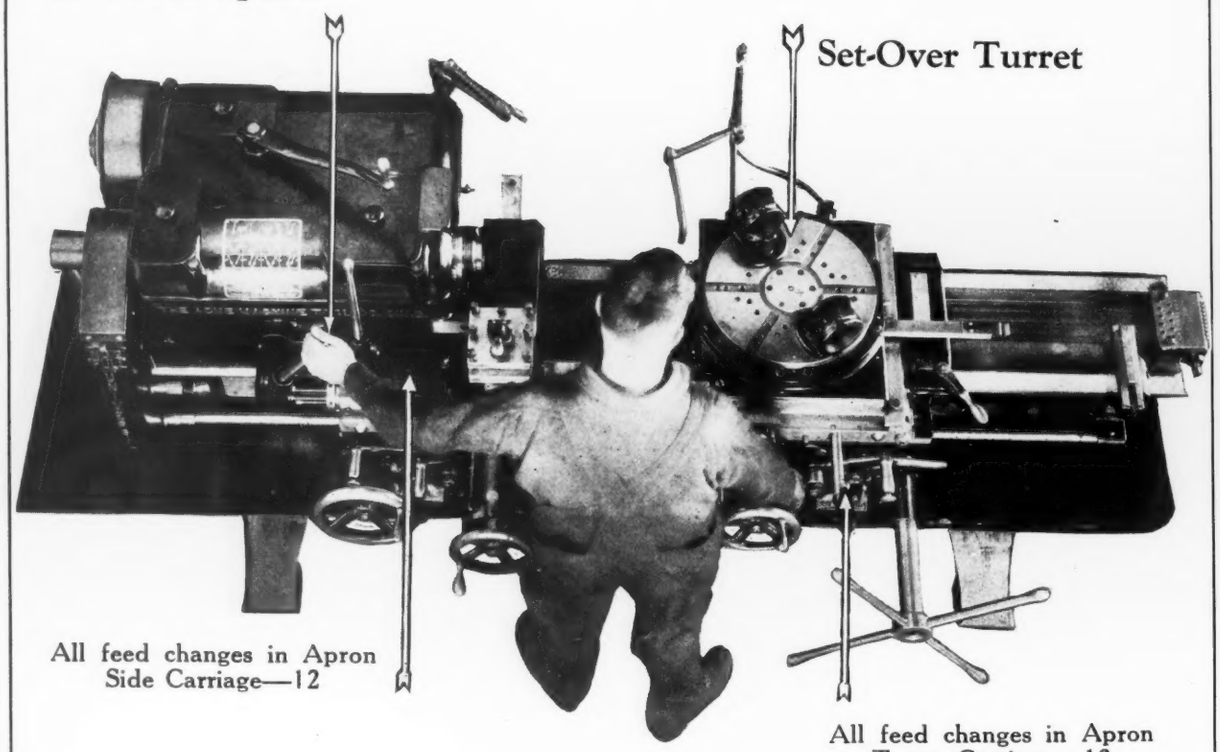
BRISTOL, CONN.

DETROIT **CHICAGO**

407

New Acme Duo Control Turret Lathe

12 Work Speeds



A Real Producer on Bar and Chucking Work

See how completely control is centered at only two points in this Acme Duo Control Lathe. All speeds and feeds are within easy reach of the operator's two hands—a big factor in lopping minutes off the production time.

This turret lathe is a real producer on both bar and chucking work. Cross sliding turret and side carriage assure simple, inexpensive tooling and rapid, easy set up.

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20-24
BOOTH NO. 217-40

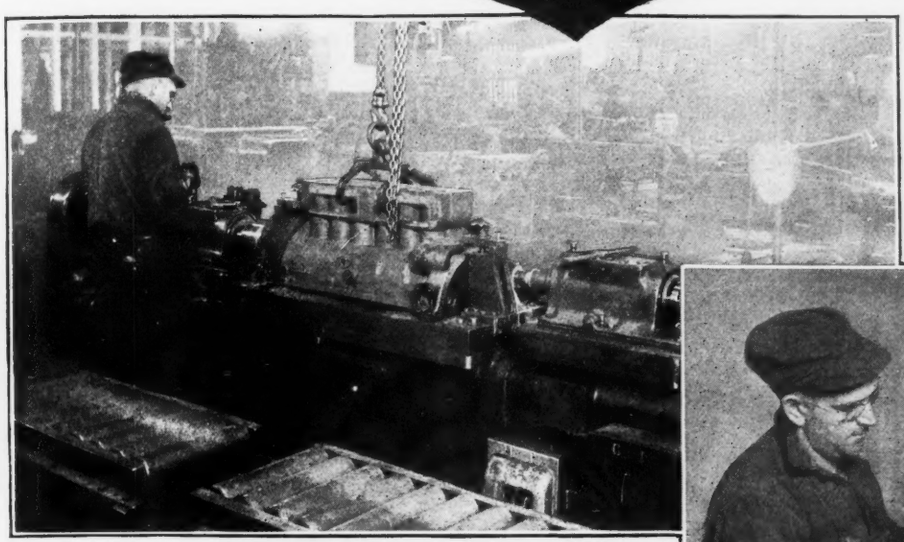
New records will be set in your shop when this Acme Duo Control starts working. Let us tell you what it will do on *your* work.

THE ACME MACHINE TOOL CO.

CINCINNATI, OHIO, U. S. A.

Agents in all leading cities in this country and abroad

Making Good



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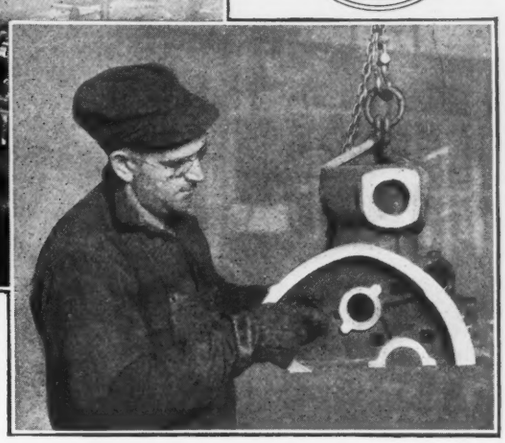
318-319



by—
Increasing Production

"They save us time, money, tools, operators—they make good." That's the consensus of opinion in some of America's leading automotive plants concerning W. F. & John Barnes Company drilling and tapping, boring and reaming machines. It tells the whole story.

Experience has proven that each one of these machines, one type shown above, will replace several standard machines and their operators, and turn out more work per hour—a tremendous saving in time, man power, and floor space.

It's easy to increase production—on paper. W. F. & John Barnes Company drilling, tapping and boring machines actually do it—day in and day out under real operating conditions where all guesswork as to costs is eliminated.

Our engineers are prepared to go into your shop, study your problems with you, and design machines that will increase production. This service is yours for the asking. Write today.

Established 1872

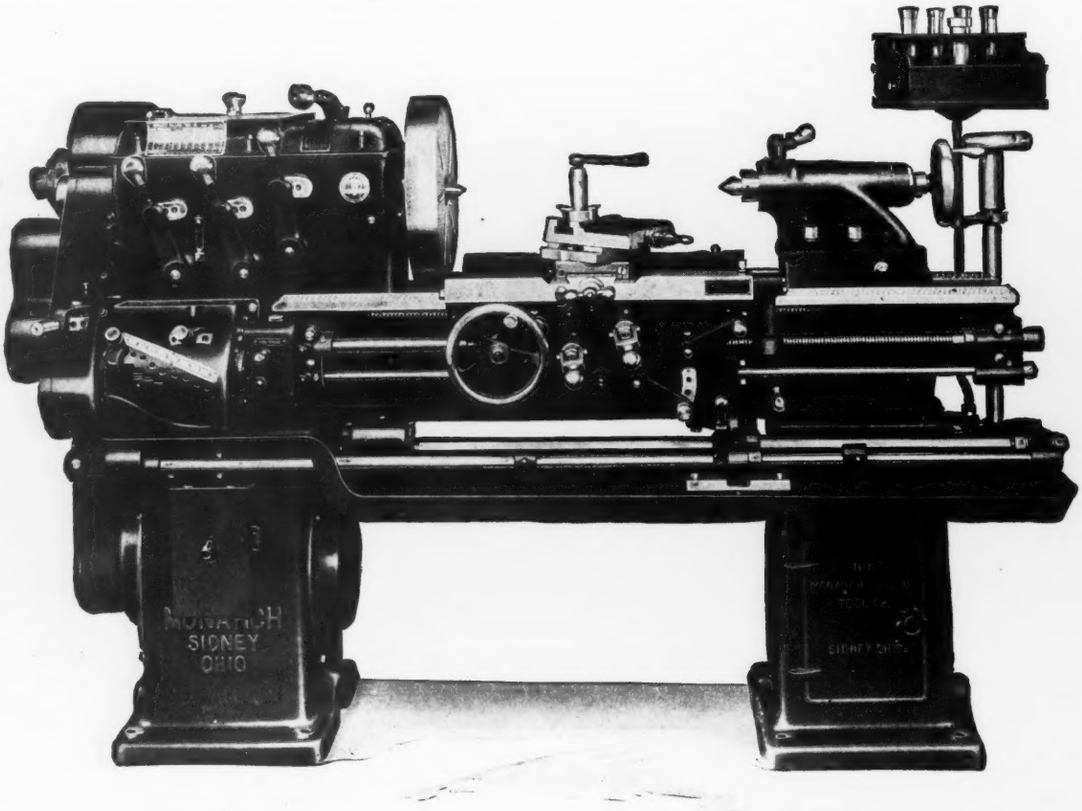
W. F. and John Barnes Co.

ROCKFORD, ILLINOIS

MONARCH HELICAL-GEARED

SILENT—SMOOTH—POWERFUL

15 to 25% More Production



Many users of the Monarch Helical Geared Lathes say their operators turn out from 15 to 25% more work on Monarch Lathes than on any other geared head lathes, because of the faster controls.

Ease and speed of feed and speed changes, starting and stopping machine, engaging and disengaging feeds, are all vital points in cost of production, both in the tool room or production departments.

WE WILL EXHIBIT
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CHICAGO
BOOTH NO. 385

On all these important points Monarch Lathes are much faster for the operator than any other geared head lathes.

Spindle speeds are changed in a fraction of a second, without drifting the spindle, and the operator never moves from his working position at the lathe.

Apron feeds are instantly engaged and disengaged,—an exclusive Monarch patented feature. Operator works to closer limits under power feed than is possible by hand feeding.

All these points are of vital importance in the selection of lathe equipment.

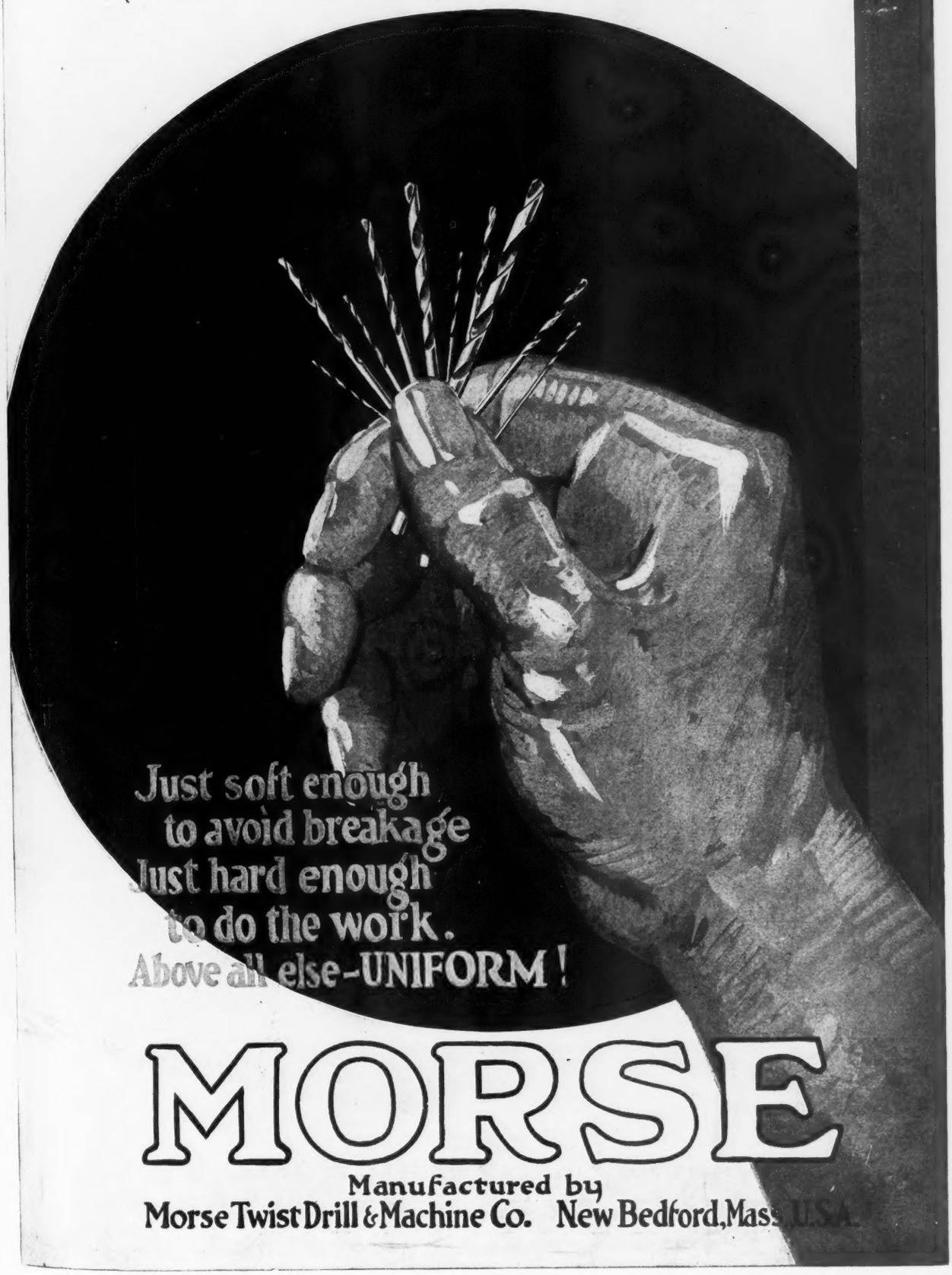
Over 1000 Monarch Helical Geared Head Lathes are now in use, many of them in shops near you. Let us tell you where you can conveniently see Monarch Helical Geared Lathes in use.

Bulletin fully describing them will gladly be sent.

THE MONARCH MACHINE TOOL CO.

SIDNEY, OHIO

The BEST in Wire Sizes!



MORSE

Manufactured by
Morse Twist Drill & Machine Co. New Bedford, Mass. U.S.A.

COLBURN

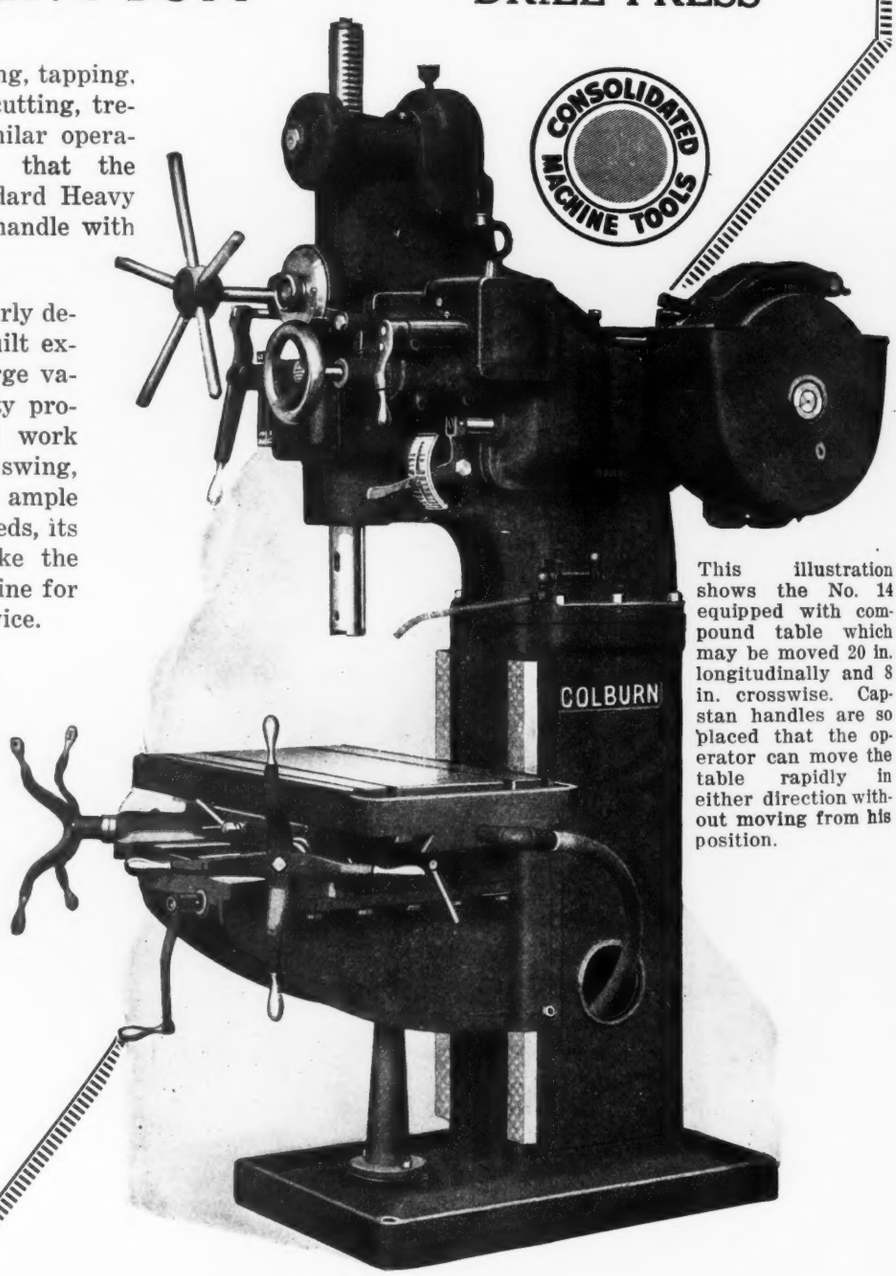
No. 14 HEAVY DUTY DRILL PRESS

Drilling, boring, reaming, tapping, hollow milling, under cutting, trepanning and other similar operations are operations that the COLBURN No. 14 Standard Heavy Duty Drill press will handle with equal facility.

This machine has a clearly defined purpose—it is built expressly to handle a large variety of work—quantity production today—special work tomorrow. Its 24-inch swing, 2-inch drill capacity, ample range of feeds and speeds, its ease of operation make the Colburn an ideal machine for general all around service.

No matter how large or how small your shop—you will find it well worth your while to install at least one Colburn No. 14.

Let us send you a copy of Bulletin No. C.D. 109.



This illustration shows the No. 14 equipped with compound table which may be moved 20 in. longitudinally and 8 in. crosswise. Capstan handles are so placed that the operator can move the table rapidly in either direction without moving from his position.

BETTS-NEWTON-COLBURN-MODERN-HILLES & JONES

CONSOLIDATED

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA, ROCHESTER, N. Y.

SUPERIOR
BALL AND ROLLER
BEARINGS

Here are some of the results obtained from the use of Superior Ball and Roller Bearings:

Efficiency **Long Life**
Satisfaction **Saving in Cost**
Saving in Power

Send for our catalog No. 10

THE BALL AND ROLLER BEARING CO.
Danbury, Connecticut, U. S. A.

HOW MUCH *do you SPEND for grinding your cutting tools*

?

Here's what some companies

SAVE

per year!!

MEESE & GOTTFRIED	$ 579.00
CANN & SAUL STEEL CO.	1,349.80
REMY ELECTRIC CO.	2,174.40
THE BROWN-LIPE-CHAPIN CO.	2,662.10
WARNER CORPORATION	3,822.30
WILLYS-MORROW COMPANY	3,824.60
BROWN HOISTING MACH'Y CO.	5,449.40
BUDD WHEEL COMPANY	8,624.80

All Using From 1 To 4

Gisholt Universal Tool Grinders

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NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT. 20-24
BOOTH NO. 272

You will be interested in seeing the application of the **Gisholt Universal Tool Grinder** to your grinding requirements.

Write for our Grinder Catalog

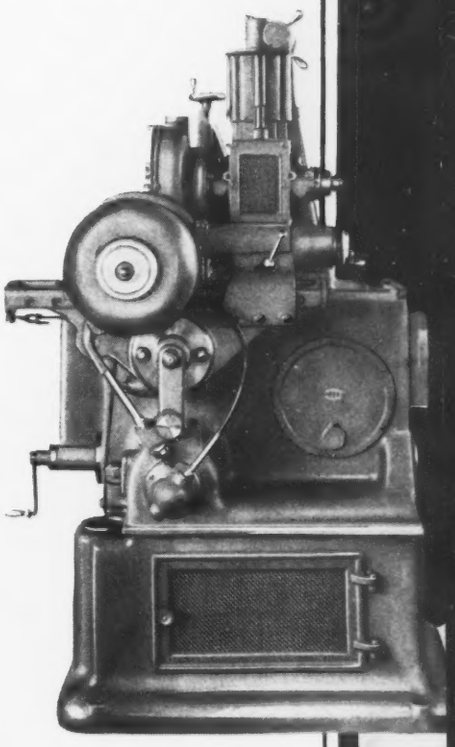
GISHOLT MACHINE COMPANY

1300 E. WASHINGTON AVE., MADISON, WIS.

...AE CLEVELAND
...TOOTH GRINDER

Simmons Method

"GIVE her the gun!" The flagship of the sky flotilla leaps forward—its engine bursting to life with a roar. A short run and then a zoom into the blue. One by one the remaining ships follow to fall in position in formation flight.



The precision of correctly ground gears having smooth, mirror-like surfaces is one of the greatest contributing factors to the success of modern high speed gear drives. The "National - Cleveland" Gear Tooth Grinder begins a new era in gear tooth grinding. This machine, with its auxiliary the "National - Cleveland" Gear Tooth Tester automatically grinds gear teeth and proves their accuracy beyond question to 0.00005″ in contour and 0.0001″ in spacing. Accurately roughed blanks *not* necessary.

THE NATIONAL TOOL COMPANY

Cleveland, Ohio

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-Cleveland Cutters

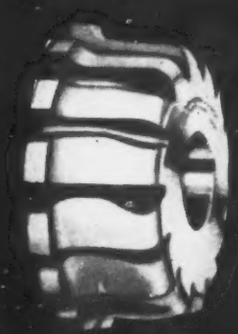
Quality Cutters For Over Twenty Years

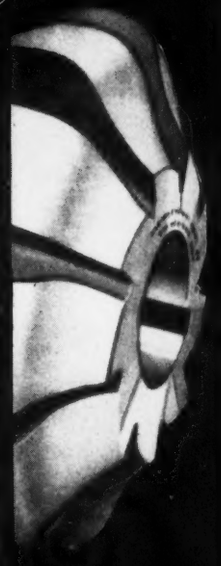
and *Quality* is the first essential of a cutter and *Service* is next in importance. A good cutter backed up by a service, the main idea of which is to help manufacturers, cannot fail in its work. Users of "National-Cleveland" cutters have the advantage of a highly specialized grinding department wherein any particular requirement in the grinding of hobs, gear shaper cutters and many types of milling cutters may be developed with closest cooperation between the department and user.

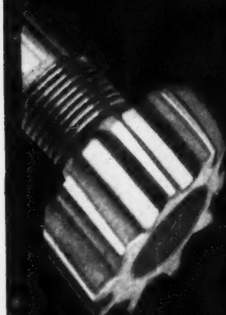
There is a "National-Cleveland" Cutter for all general and special purposes. Each cutter a past master at its work.

Men of long experience, specialists in cutter design, stand ready to work with you in your cutter problems. Call on us. We may be in a position to suggest the very cutter for your particular job.

"National-Cleveland" service is no further away than our nearest office.







THE NATIONAL TOOL COMPANY

Cleveland, Ohio

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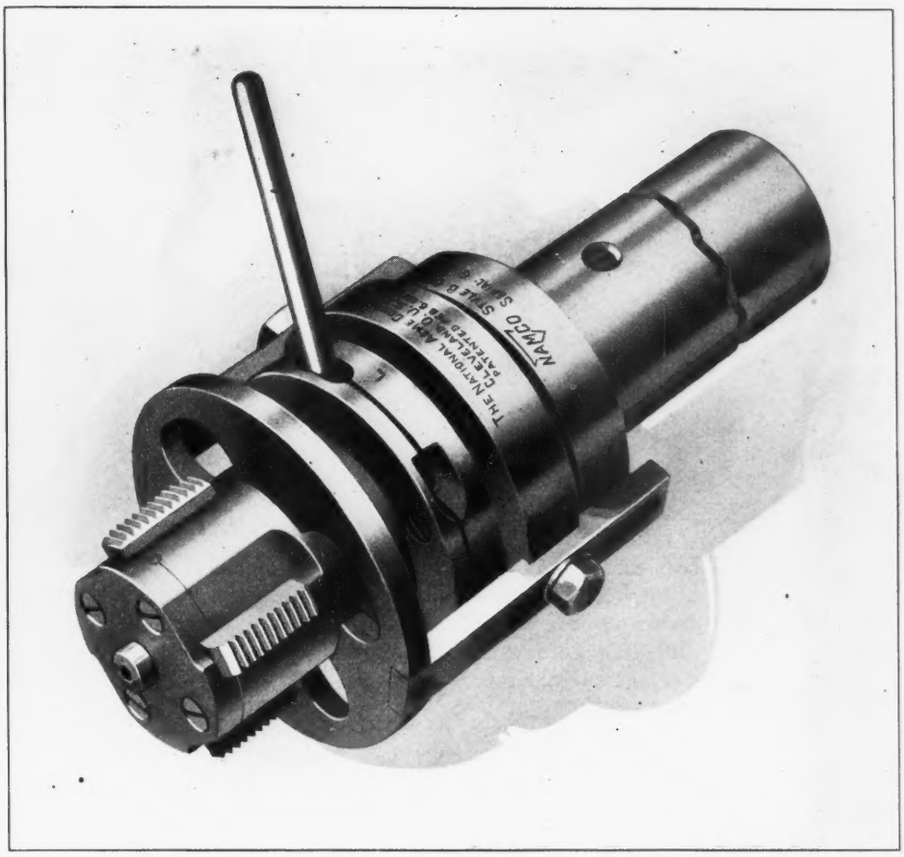
41 Murray St.

Philadelphia
816 Chestnut St.

Detroit
5-116 General Motors Bldg.

Chicago
624 Madison Term. Bldg.
9 South Clinton St.

Here's a New Tap for You



Here's a New Collapsible Tap that you need on your tapping work. It's simple, it's easy to adjust for size, it's sturdy, it collapses instantaneously and at the desired depth.

Notice the heavy front plate. It is recessed and fitted closely over the body of the tap, thus preventing the chaser slots from spreading or getting sloppy. Notice the adjusting ring. Just a few twists of the wrist with a screw driver and the proper size adjusment is made, yet the adjusting screws are locked in place so they can't work loose.

Remember that on NAMCO Taps the chasers are rigidly supported throughout their entire length while the thread is being cut—they do not drop off from shoulders or pull off from pins, but rather collapse instantaneously as the core piece rotates into the collapsing position.

15 sizes to choose from—$\frac{7}{8}$" to $7\frac{1}{8}$" cutting capacity. Order one and try it on your work.

THE NATIONAL ACME COMPANY

Cleveland, Ohio

New York Detroit Chicago

We also manufacture revolving and stationary Self Opening Dies

The Recognized Standard of Seamless Steel Tubing

for machine-tool and general machinery construction; structural purposes and tool-room requirements; hollow-forgings, parts and complete articles; and numerous important special uses.

Ask for Booklet—
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Remember! There Is a

"NATIONAL SHELBY"

Seamless Tube for Every Mechanical Purpose

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

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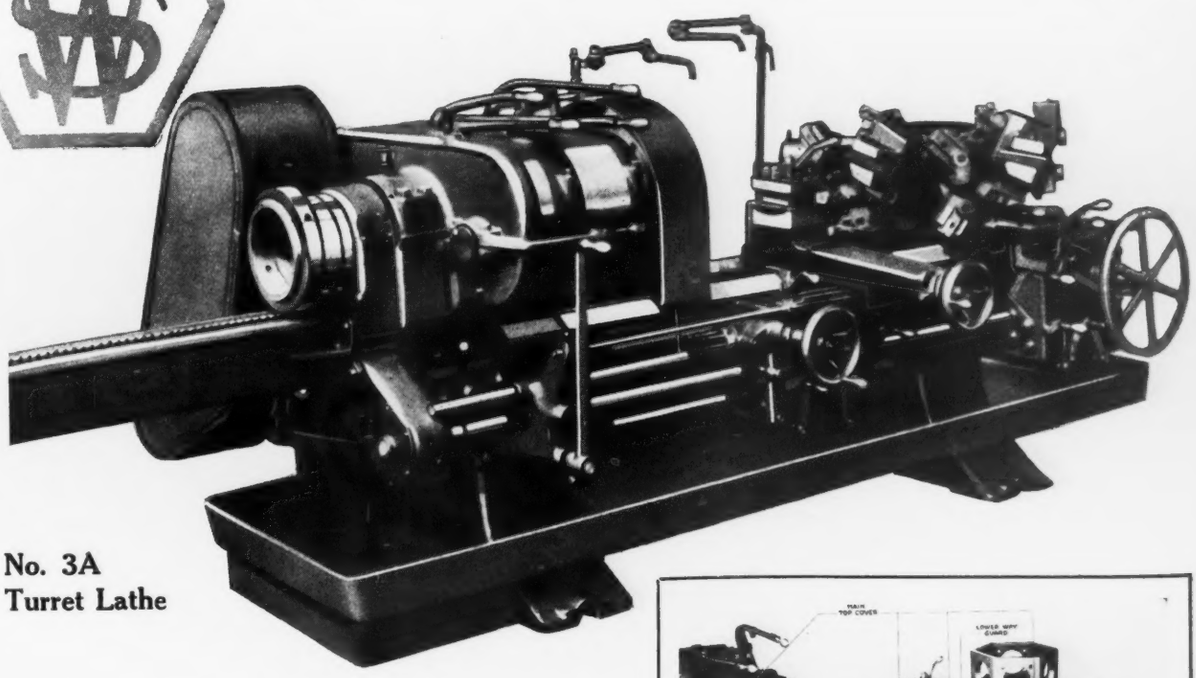
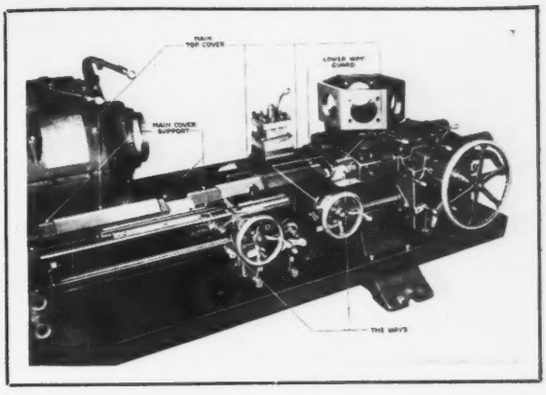


No. 3A
Turret Lathe



Way-Covers *Plus*

Nothing but oil can reach the ways of the new Warner & Swasey No. 3A turret lathe. They are completely and permanently protected by *Way Covers*, a construction that prolongs the built-in accuracy of the machine. Ever before see a turret lathe with covered ways?

There are other important features in our latest and largest turret lathe. The Hexagon turret has 16 feeds and power rapid traverse. Twelve geared-head work speeds are provided. Head is cast with bed and the whole carries full load of 25 H.P. motor drive without a tremor. Alloy steel gears in head are mounted on roller bearings. Hexagon and square turrets operate in unison or independently.

The new 3A takes bars up to 7½″ diameter, swings 25¼″ diameter over way-covers and has a maximum turning length of 39″.

Performance of the machine is clearly described in our new 3A circular. This circular will enable any manufacturer to appraise for himself the money making possibilities that this machine contains for him. Circular sent upon request without cost or obligation.

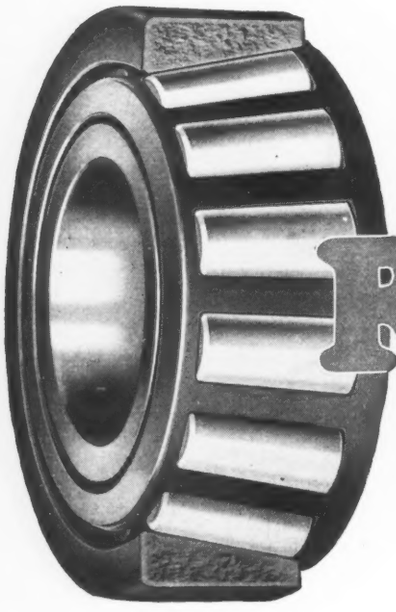
The Warner & Swasey Company

CLEVELAND, OHIO, U. S. A.

NEW **YORK:** Singer Building
BOSTON: Chamber of Commerce Building
BUFFALO: Iroquois Building
PITTSBURGH: Chamber of Commerce Building
PHILADELPHIA: 95 Keystone Ave., Upper Darby

LOS ANGELES: 228 Central Avenue
DETROIT: 5928 Second Boulevard
CHICAGO: 618-622 Washington Boulevard
MILWAUKEE: 1143 Wells Building
DAYTON: 518 Mutual Home Building

TIM Tap ROLLER



Norton Floor Stands run on Timkens

More grinding at the wheels—none in the perfectly enclosed, easy-rolling, power-saving Timken Tapered Roller Bearings.

On simple mountings, in compact housings which keep out dirt and hold the grease, Timken Bearings carry the speed, intermittent load, thrust, and shock of grinder operation.

Greater load area, inherent in Timken Tapered design, means extreme rigidity in Timken-equipped Norton grinders. Timken positively aligned rolls improve machine precision as well as speed possibilities. And Timken-made electric steel is assurance of finest material where it is most needed.

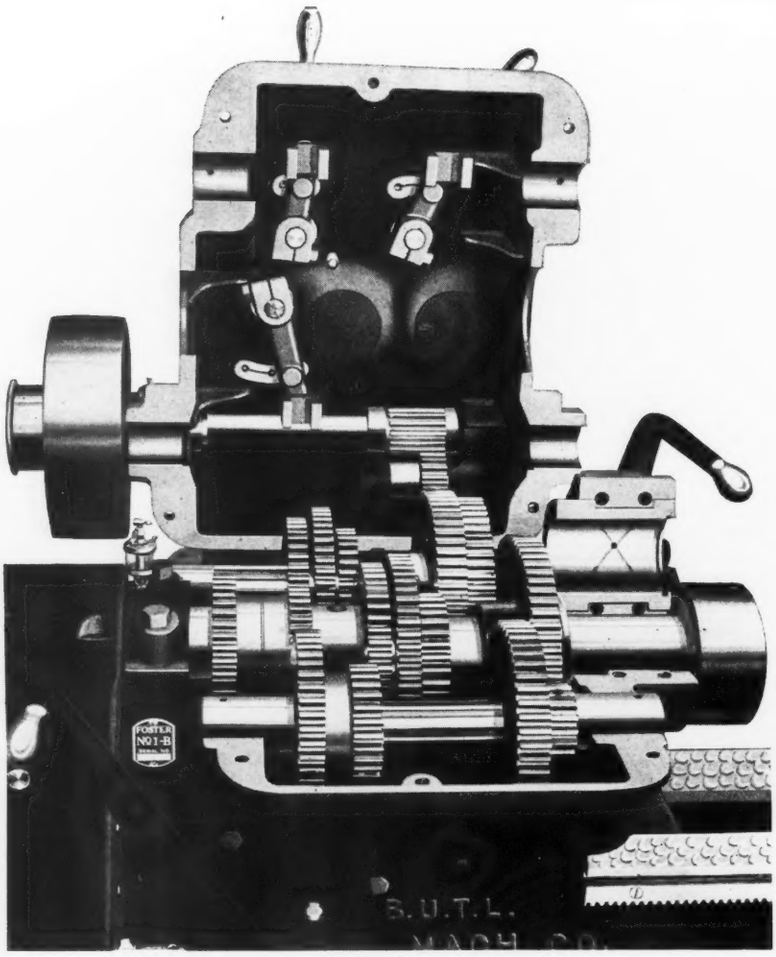
The growing use of Timken Bearings by such manufacturers as Norton, shows how sound is the effect of Timken Bearings in modern industrial economy.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN

Tapered

BEARINGS



THE NEW FOSTER 1-B Universal Turret Lathe

Five Big Features of the Head

The front and back shafts are of chrome nickel steel heat treated. They are splined in place of being keyed to drive the clash gears.

All gears are of forged steel heat treated and run in a bath of oil.

The spindle is chromium manganese forging. After rough turning it is heat treated and drawn to an average hardness and ground to final size. Short overhang gives great rigidity to chuck. The spindle bearings are of special bronze and cannot flow under the most severe load conditions.

Twelve selective spindle speeds forward and reverse to the spindle make the machine capable of handling a wide range of work.

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NATIONAL STEEL & MACHINE TOOL EXPOSITION
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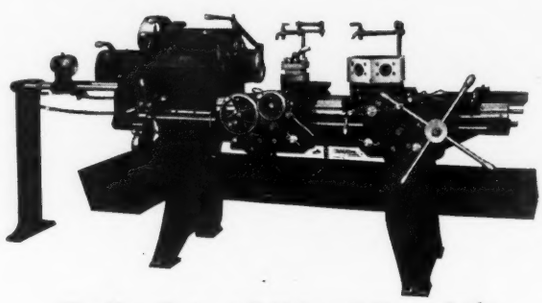
BOOTH NO. 267

Our new catalogue covers several new features not found in the 1-B machines of earlier design. The new improvements give this machine a greater productive capacity.



The New Foster 1-B Universal Turret Lathe

Let us show you low production figures from your blue prints or samples.

FOSTER MACHINE COMPANY, Elkhart, Indiana

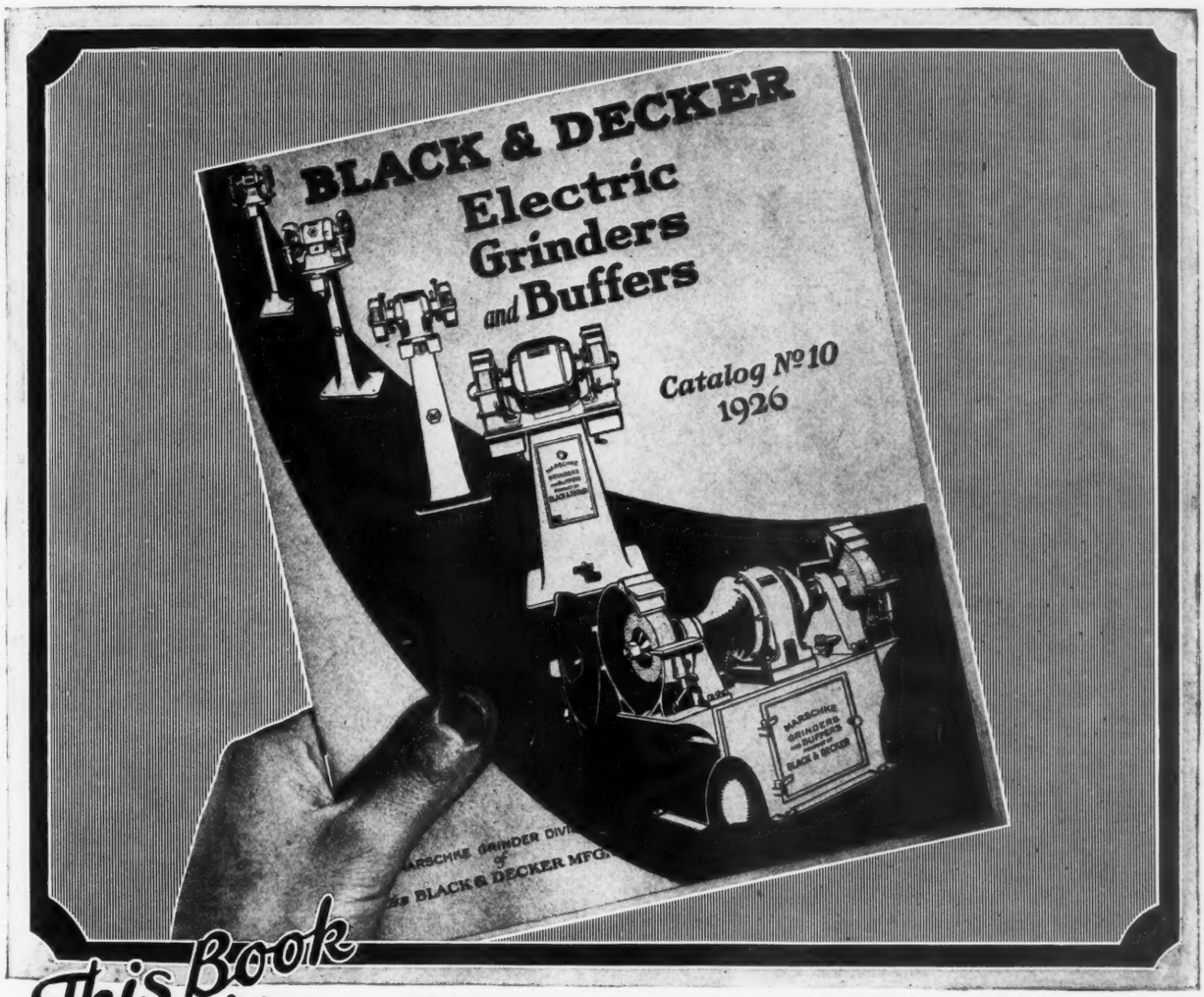
BLACK & DECKER

announce a complete line of

Electric Grinders

From 6 inch, ½ horsepower to 30 inch, 20 horsepower

The new No. 10 Catalogue, describing these Grinders in detail with prices, is now available.



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This book will be sent FREE to readers of MACHINERY who fill in and return this coupon to us.

THE BLACK & DECKER MFG. CO.
TOWSON, MARYLAND

Please send to me, without charge, your new No. 10 Electric Grinder Catalogue, as advertised.

Name.....

Address.....

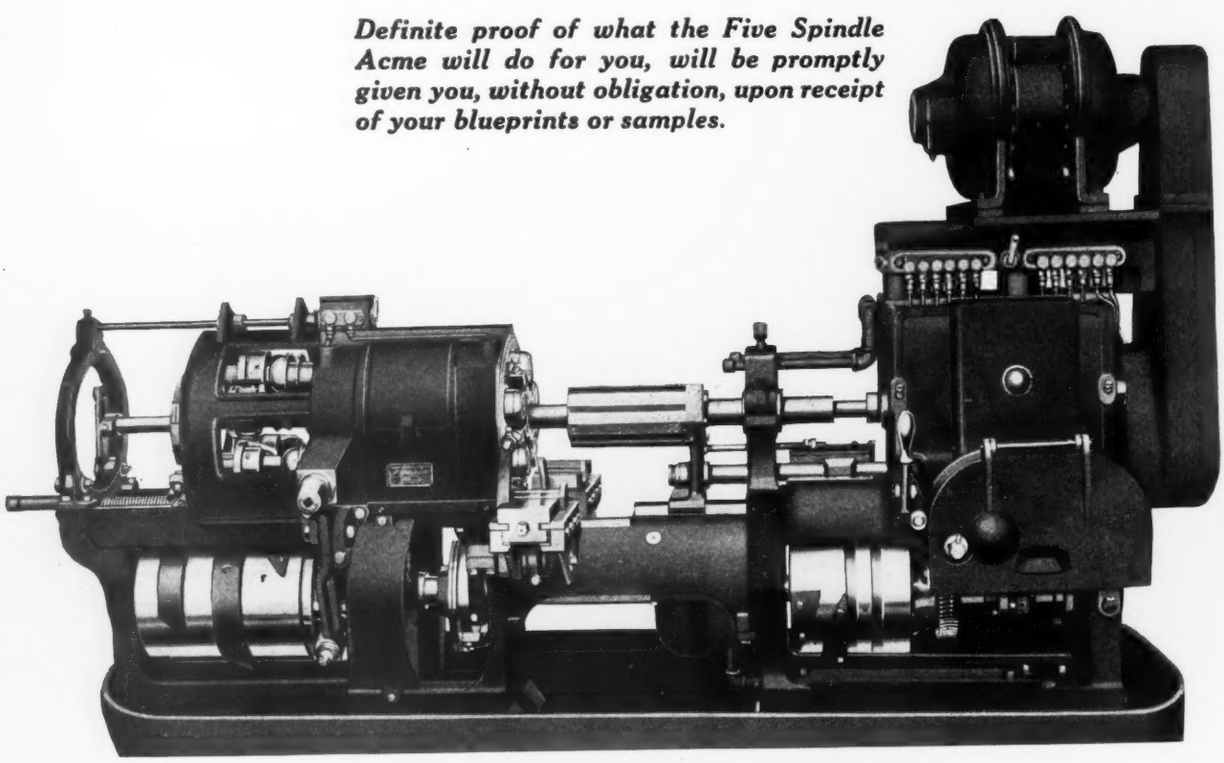
Have You Seen the Model C Acme in Action?

Have you seen the Model C, Five Spindle Acme Automatic Screw Machine at work? If you haven't, plan to attend the New Haven Machine Tool Exhibition, or the Steel Treaters Show in Chicago.

For here's a machine that offers extraordinary economies in producing parts from bar stock; a machine offering unusual construction features which make possible this fast production, and at the same time permit high standards of accuracy.

If you can't get to New Haven or Chicago, visit our plant at East 131st & Coit Road, Cleveland, Ohio, where we have 24 Five Spindle Acmes at work.

Definite proof of what the Five Spindle Acme will do for you, will be promptly given you, without obligation, upon receipt of your blueprints or samples.



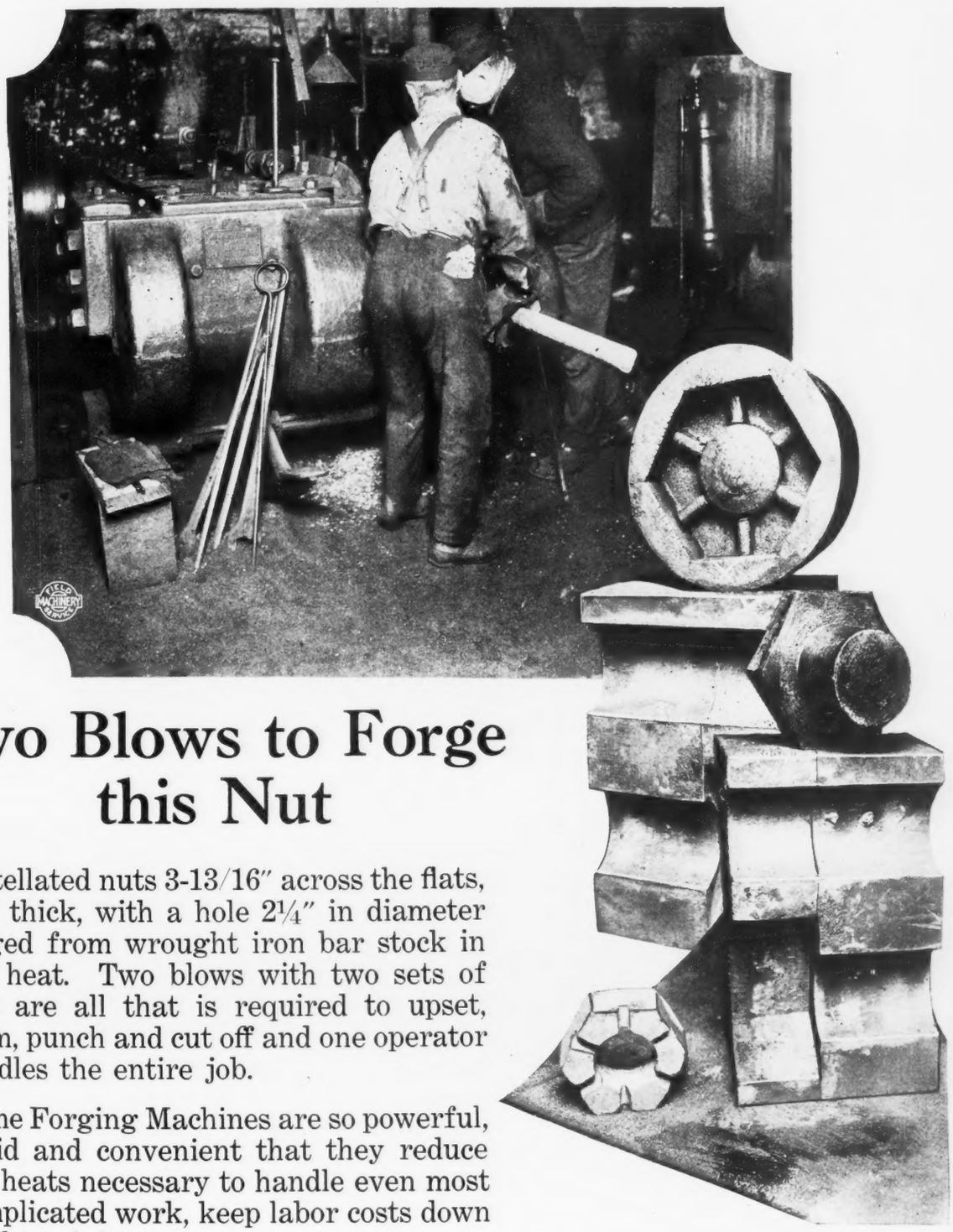
The Model C, 5 Spindle Acme Automatic now built in 3 sizes—9/16″—1″—1⅝″.

The National Acme Company

Cleveland, Ohio

New York Detroit Chicago

Makers of Threading Dies, Collapsing Taps and Screw Machine Products at Cleveland, Ohio and Gridley Multiple and Single Spindle Automatics and Gridley Chucking Machines at Windsor, Vermont.



Two Blows to Forge this Nut

Castellated nuts 3-13/16″ across the flats, 1½″ thick, with a hole 2¼″ in diameter forged from wrought iron bar stock in one heat. Two blows with two sets of dies are all that is required to upset, form, punch and cut off and one operator handles the entire job.

Acme Forging Machines are so powerful, rapid and convenient that they reduce the heats necessary to handle even most complicated work, keep labor costs down to the minimum.

Acme Forging Equipment gives continuous profitable service under most severe working conditions.

Let us show you records of some interesting installations

THE ACME MACHINERY COMPANY

CLEVELAND, OHIO, U. S. A.

Foreign Agents: Burton, Griffiths Co., Ltd., London. Glaenzer & Perreaud, Paris, France.

And now a new DIXON *eraser*

DIXON
CARNATION ERASER

We know you're going to like the Dixon Carnation Eraser. Just give it a tryout and watch the way it *knuckles down* to its job and *cleans-up* as it goes along. Our special process is responsible for its constant pliable efficiency. The more you use a Dixon Carnation Eraser, the more you'll realize it's the eraser you should keep within easy reach always.

Sample Offer—*To give you the opportunity to see how the Dixon Carnation Eraser knuckles down and cleans-up, we will send you one free upon receipt of your name and address.*

JOSEPH DIXON CRUCIBLE CO., PENCIL DEPT. 74-J JERSEY CITY, N. J.

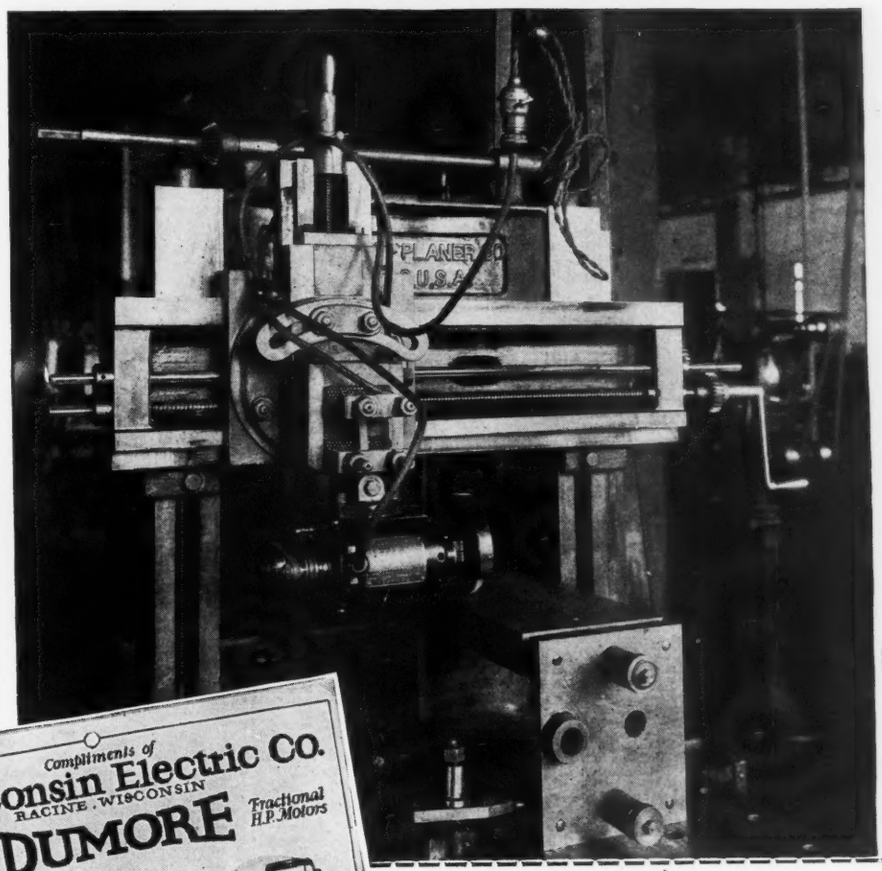
© 1926 Joseph Dixon Crucible Company

FINISHED—at one setting

WHEN specifications call for finish by grinding to close tolerance limits, a Dumore Grinder proves its value. On almost any machine tool—planer, shaper, lathe or milling machine—the Dumore can be used to finish any surface—flat, round, eccentric or irregular, to the required dimensions—usually without changing or disturbing the original set-up.

Six styles, all vibrationless, cover all requirements for fine external or internal grinding, at prices ranging from $50 to $180. Write for our new exchange offer.

Have you a Dumore Tap Drill Chart? If not, let us send you one. It's free. Mail the coupon.



Wisconsin Electric Company,
25 Sixteenth St., Racine, Wis.

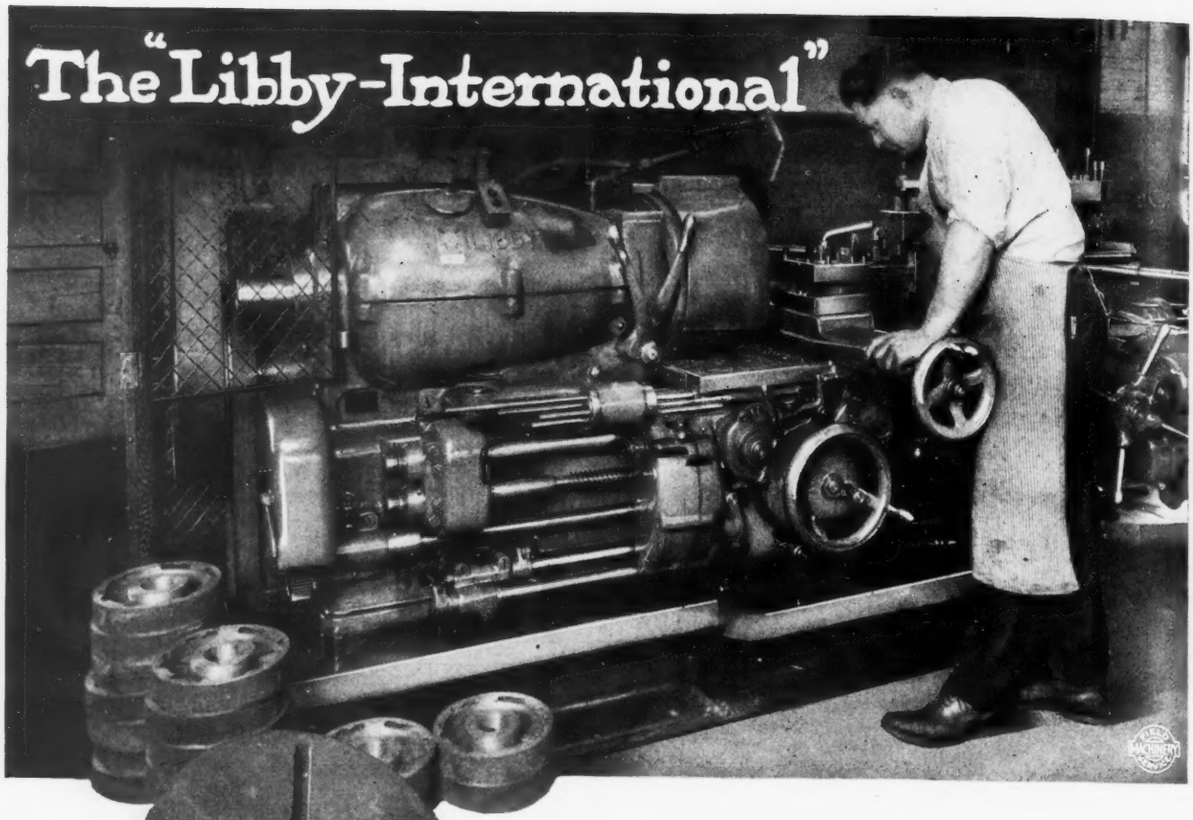
Please send me, free of charge, one of your Tap Drill Charts, a catalogue of Dumore Grinders, and details of your new exchange offer.

NAME .....

ADDRESS .....

CITY .....STATE .....

Wisconsin Electric Company 25 Sixteenth St., Racine, Wis.



Turning Cast Iron Chuck Bodies

This "Libby-International" is shown at the plant of the Cushman Chuck Company, Hartford, Conn., set up for turning 9″ diameter cast iron chucks to a tolerance of .0005″ on the diameter of the hub and .001″ on the height.

The operator first turns the face of the chuck, then the outside diameter half-way its length;—reverses the chuck and then faces, bores, reams the hole and finish turns the inside of the chuck. *Fifty chucks* are turned on the "Libby-International" *without grinding the finishing tools.*

On all kinds of heavy duty jobs "Libby-International" lathes hold their own in maintaining high production without sacrificing accuracy. May we tell you more about "Libby-International" Lathes and what they are doing?

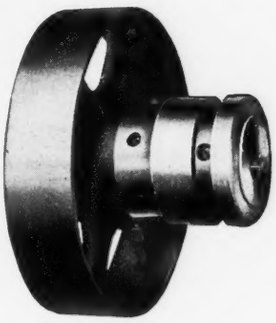
INTERNATIONAL MACHINE TOOL CO., Indianapolis, Indiana

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill & Co., St. Louis, Mo.; Brown & Zortman, Machinery Co., Pittsburgh, Pa.; Waterhouse & Lester Co., San Francisco, Cal., Los Angeles, Cal.; E. L. Essley Machinery Co., Chicago, Ill., Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass.; Seifreat-Elstad Co., Cincinnati, Ohio, Dayton, Ohio; Cadillac Machinery Co., Detroit, Mich.; Strong, Carlyle & Hammond Co., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York City, N. Y., New Haven, Conn.; Philadelphia, Pa.; Peden Iron & Steel Co., Houston, Texas. FOREIGN AGENTS: Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque Todd & Co., Belgium; V. Lowener, Copenhagen, Denmark, Oslo, Norway, Stockholm, Sweden; Victor B. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France; Mitsui & Co., Japan.

THE JOHNSON FRICTION CLUTCH

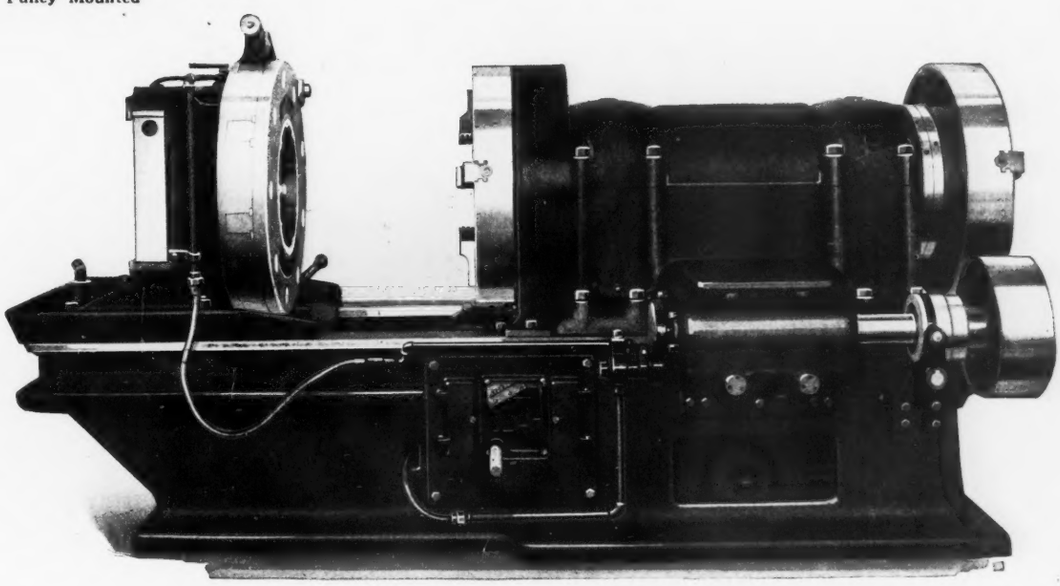
As Used On the New

Williams No. 12 Rapiduction Pipe Threading Machine



Single Clutch, Pulley Mounted

Yes, here's another new Williams Pipe Threading Machine coming out JOHNSON Clutch-equipped. Given an effective try-out on their No. 4 and No. 6 Pipe Threading Machines, and proving their efficiency by giving highest grade service, JOHNSONS were the logical choice for the new No. 12 Williams Machine.



COURTESY: The Williams Tool Corporation, Erie, Pa.

This often happens: When a machine builder adopts JOHNSON Clutches for one machine, the JOHNSONS give such complete satisfaction that he later installs these on three, six, and sometimes ten different types of machines.

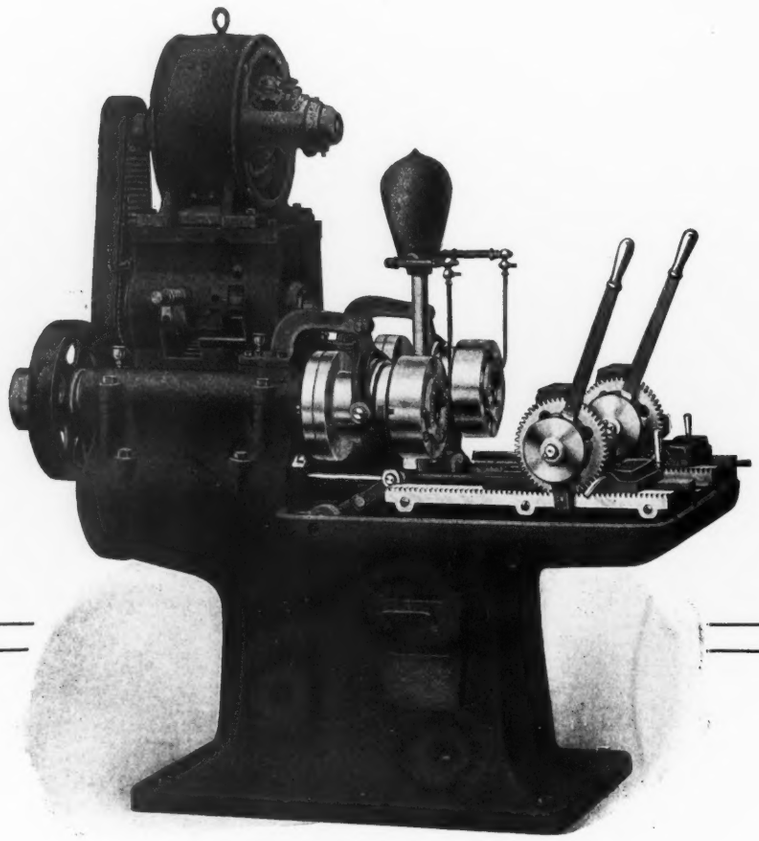
On the Williams No. 12 Pipe Threading Machine shown above, a No. 10 Single JOHNSON Friction Clutch delivers the power to the gear box for either motor or belt drive. Equip your machines with JOHNSON Clutches.

Write for Catalog "A"

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

NATIONAL OPEN DIE BOLT CUTTERS

"ALWAYS CUT ACCURATE THREADS"

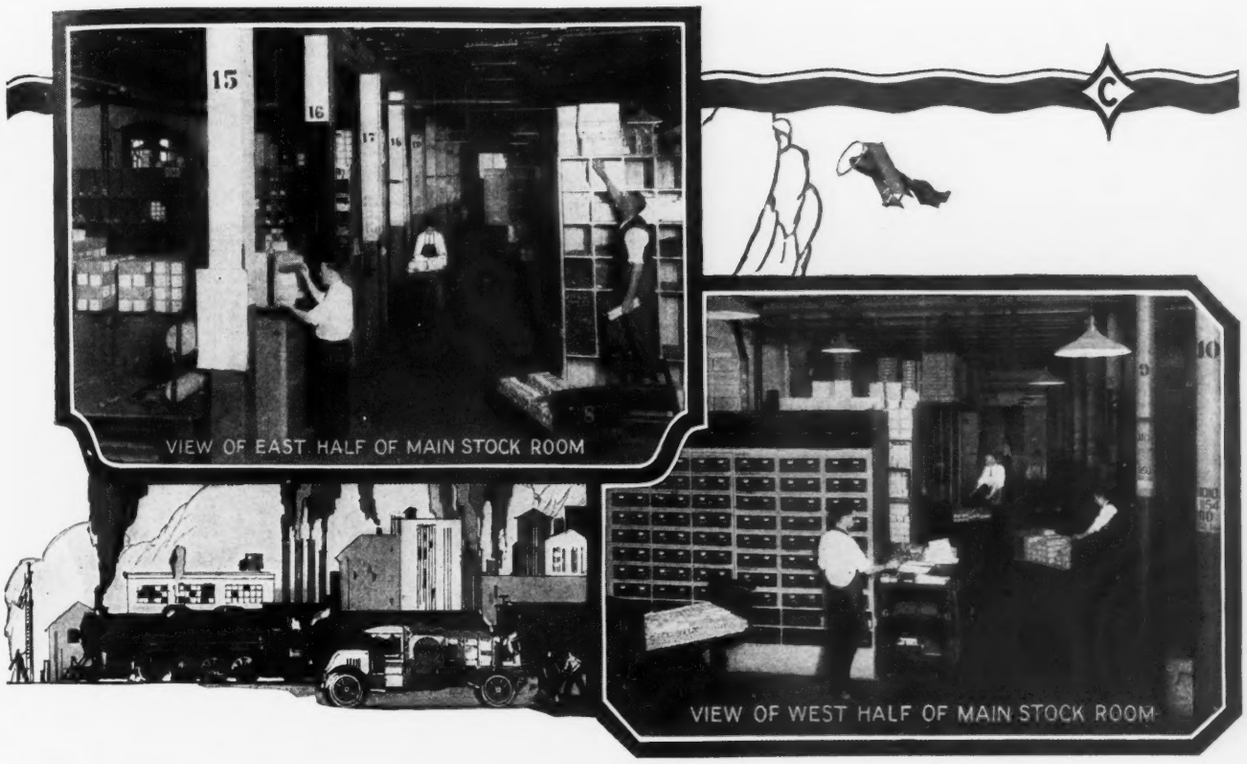


THE National Open Die Bolt Cutter always cuts accurate threads because the Die Head cannot spring open and cut tapering or oversize threads, regardless of variations in the diameter or hardness of the material being threaded. As no wear can be transmitted to the dies, this high degree of accuracy is maintained thruout years of hard service.

In addition, the National Interchangeable Case Die insures low die cost—many users reporting that their die costs have been reduced 30 to 50%.

It will pay you to investigate the National.
Send for full details.

The National Machinery Company, Tiffin, O.



What you need—
When you want it!

DESPITE the complexity of the twist drill and reamer business, which involves the manufacture of more than 15,000 different kinds and sizes of small tools, "Cleveland" customers quickly discover that their orders flow into and out of the factory with surprising and gratifying speed. Rarely is it necessary to "hold up" an order because the kind or size of tool is not in stock.

This is due entirely to the fact that, in our Stock Rooms, are maintained at all times an average of some 8,000,000 finished tools, occupying approximately 125,000 cubic feet of space, ready for immediate shipment.

Not much to boast about, perhaps,—but yet *one* of the *many hidden* reasons which, taken as a whole, go far to explain why "Cleveland" tools are so universally preferred.

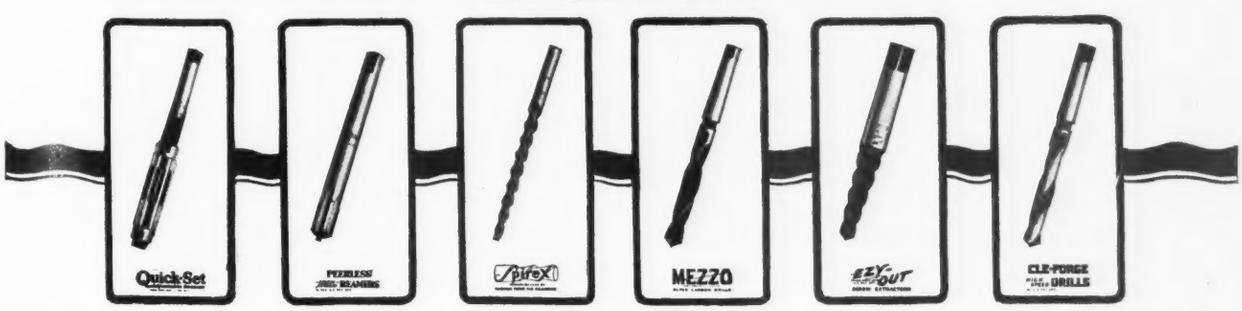
The CLEVELAND TWIST DRILL COMPANY
CLEVELAND
NEW YORK · CHICAGO · LONDON

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

TRADE MARK REG. U. S. PAT. OFF.

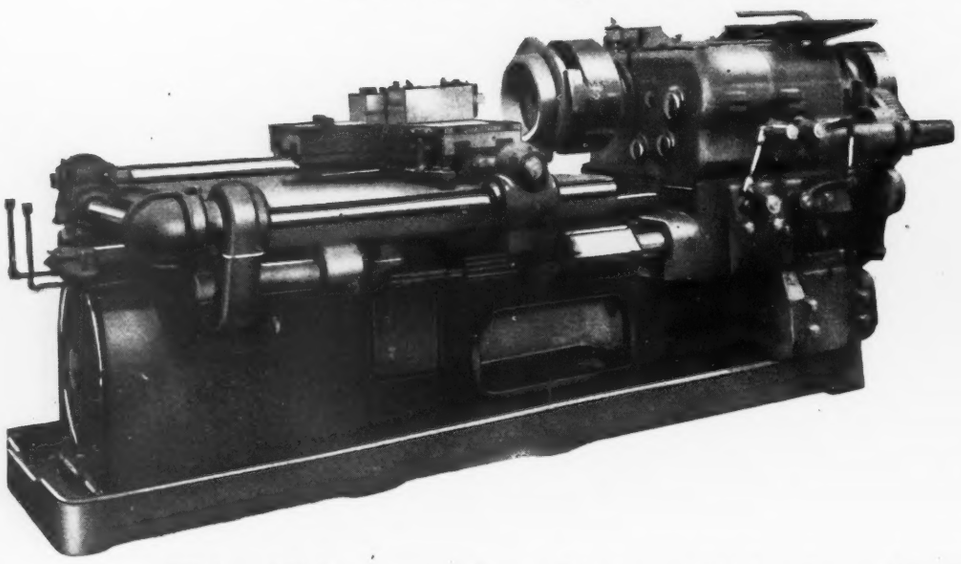
TRADE MARK REG. U. S. PAT. OFF.

Manufacturers of Carbon and Cle-Forge High Speed Drills for every purpose; "Mezzo" Super-Carbon Drills; Hand, Jobbers' and Shell Reamers; "Peerless" High Speed Reamers; "Paradox" Adjustable Reamers; "Quick-Set" Reamers; "Spirex" Machine Taper Pin Reamers; Chucking Reamers for Turret Lathes; Counterbores; Countersinks; Sockets; End Mills; and the "Ezy-Out" Screw Extractor.

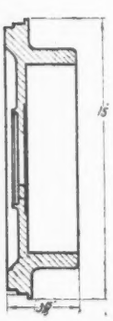


POTTER & JOHNSTON AUTOMATICS

6 D P-Platen Type Automatic Chucking Machine



WE WILL EXHIBIT AT THE *Sixth Annual* NEW HAVEN MACHINE TOOL EXHIBITION *September 7-8-9-10* NEW HAVEN - CONN - 1926



This addition to our line of Automatics has been developed for handling work which should be set aside to cool, or for heat treatment following the removal of the scale and then rechucked for finishing.

For work suited to this method of finishing, the 6 D P-Platen Type will be found a most economical and satisfactory production unit.

TYPICAL FLYWHEEL

1st Oper. 3.20 Min.
2nd Oper. 3.06 Min.
3rd Oper. 3.45 Min.
4th Oper. 3.45 Min.

ALL CUTS TAKEN SIMULTANEOUSLY

THE LONGEST CUT GOVERNS THE TIME PER OPERATION

ONE COMPLETE FLYWHEEL PER OPERATOR EACH 3.45 MINUTES

LET US HAVE YOUR PRINTS FOR ESTIMATE

WE WILL EXHIBIT NATIONAL STEEL & MACHINE TOOL EXPOSITION CHICAGO MUNICIPAL PIER SEPT. 20-24 BOOTH NO. 289-93

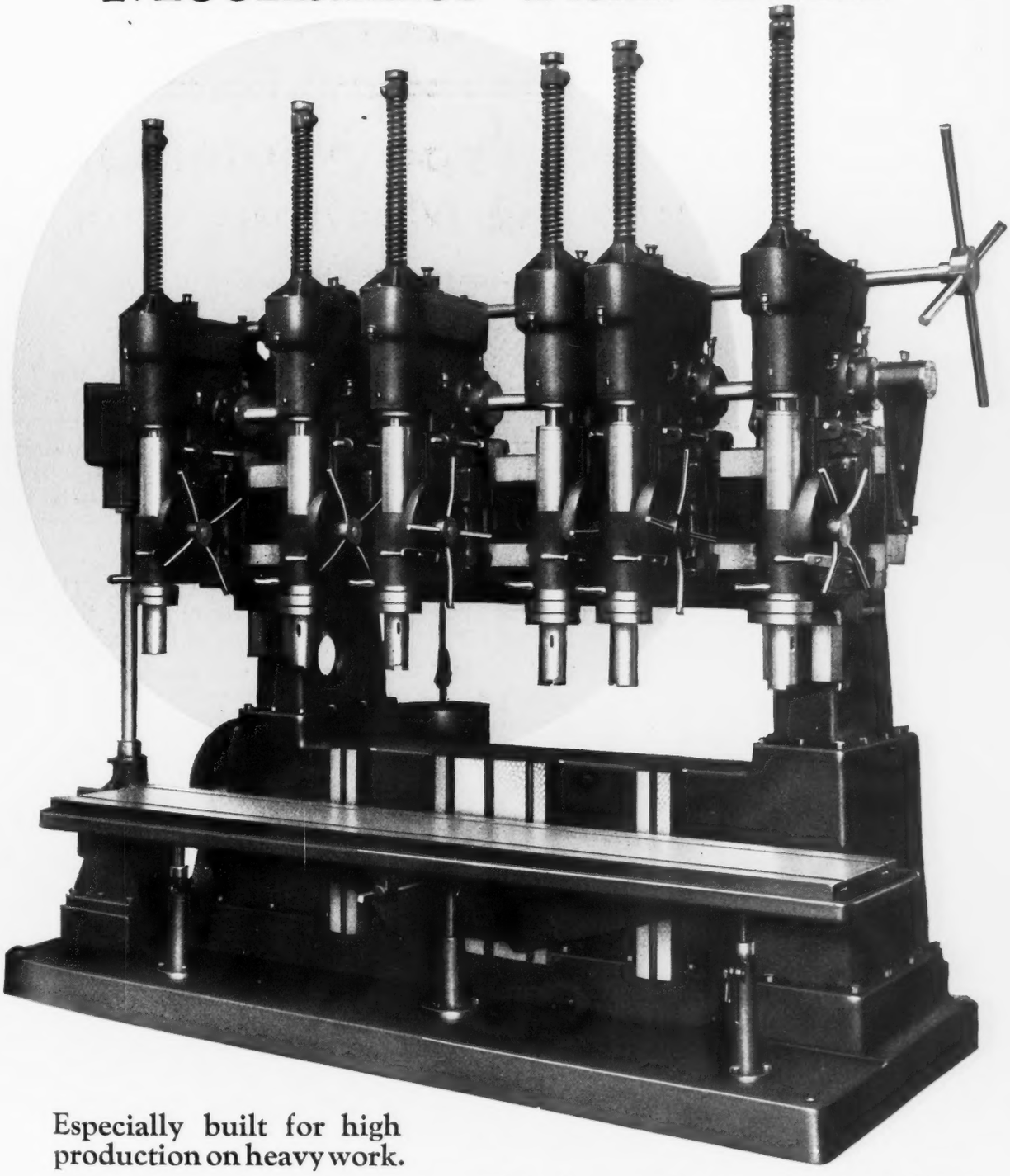
POTTER & JOHNSTON

PAWTUCKET, R. I., U. S. A.

DOMESTIC OFFICES: New York Office—270 Madison Ave., Frank H. Robinson, Manager. Detroit Office—The Potter & Johnston Agency Company, 16th & Pine Sts. Chicago Office—3057 Eastwood Ave., Leslie J. Orr, Manager. Pacific Coast Offices—Louis G. Henes, 1418 Santa Fe Ave., Los Angeles, Cal. Louis G. Henes, 75 Fremont St., San Francisco, Cal. Canadian Office—Arthur Jackson, 32 Glenholme Ave., Toronto 10, Ontario.

FOREIGN REPRESENTATIVES: L. J. Colomb, 68 Avenue de la Grande Armee, Paris, France, Representative for France, Belgium, Switzerland, Spain and Portugal. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Via Parini 10, Milan, Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake Company, No. 7 Nakadori, Marunouchi, Tokyo, Japan. Schuchardt & Schutte, C-2 Spandauer Strasse, 28-29, Berlin, Germany, Representatives for Germany, Austria and Czechoslovakia.

Mechanics Rail Drill

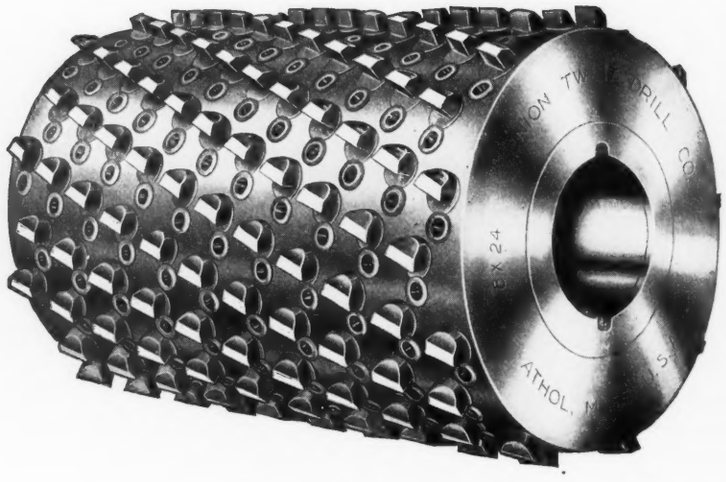


Especially built for high production on heavy work.

The minimum spindle to spindle distance is 9". Gears of heat treated alloy steel, drive gears run in oil.

Crown gears and horizontal and vertical drive shafts run in Hyatt Bearings. Two to six spindle gangs. Details and Prices on request.

ROCKFORD MACHINE TOOL CO., 2400 Kishwaukee Road Rockford, Illinois



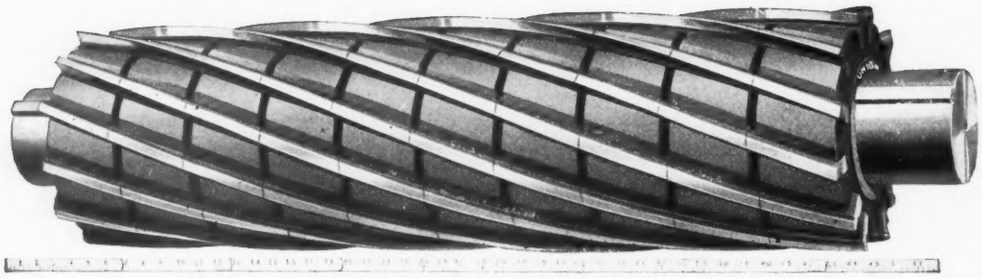
As sturdy as a solid cutter

THE design of the teeth and the method by which they are held to the cutter body, make Union Inserted Tooth Milling Cutters as sturdy on the tough jobs as a solid cutter.

It is impossible for the teeth to slip once they are set for service. Union Inserted Tooth Milling Cutters represent the acme in cutter economy, and the teeth of all our standard types are carried in stock.

We make Inserted Tooth Cutters for your own Special Purposes and guarantee them to stand up to the work for which they are made. Let us tell you something about the UNION Line.

UNION
Inserted Tooth
Milling Cutters



UNION TWIST DRILL CO., Athol, Mass.

Chicago Store: 11 So. Clinton St. **New York Store: 62 Reade St.**

Makers of All Kinds of Cutters, Twist Drills, Reamers, Taps, Dies, Etc.

AGENTS THROUGHOUT THE WORLD

CARD

From the Cost Standpoint— First or Last You are Safe *with* Card Taps

THERE may be only a slight difference in the first cost of the taps you buy; but there is a great difference in final cost when accuracy, speed of operation and number of holes tapped are considered.

Buying at a low first cost standpoint may mean greater expense in the end. Buying from an established, successful manufacturer whose products have stood the test of time safeguards your investment both in first cost and last cost.

Card made taps in 1874. Today the Card factory is one of the largest and best equipped plants in the world devoted to the manufacture of Taps and Dies.

Catalog 31 is our latest; let us send it.

The CARD Quality

S.W. CARD MFG. CO.
DIVISION OF UNION TWIST DRILL CO.
MANSFIELD, MASSACHUSETTS, U.S.A.

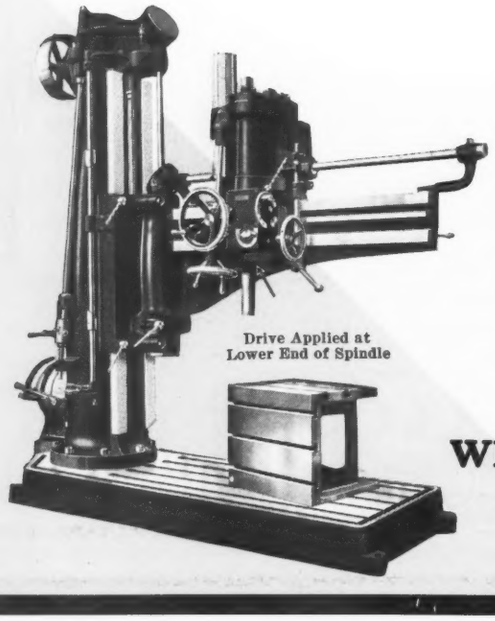
Garvin Automatic Tapping Machines

Satisfactory Wherever Installed

One of the fastest operating automatic tapping machines on the market. Runs taps to their limit of production without damage to the work or tools—and without sacrificing the accuracy required for the most exacting work.

The simplicity of operation is outstanding. The operator merely locates the work under the tap,—pulls down the lever until the tap engages the work. From there on the action is entirely automatic;—the tap runs itself to a predetermined depth—automatically reverses and backs out of the work—leaving clean cut threads and without stripping the last thread.

All revolving parts rotate on Timken Roller Bearings, insuring freedom from vibration at any speed.



Drive Applied at Lower End of Spindle

Western Radial Drills

The exclusive "Low Hung Drive" of Western Radials eliminates power waste and delivers maximum power at the point most needed—the lower end of the spindle. This feature insures uniform speeds and feeds under the most adverse conditions without danger of chatter or stalling.

WESTERN MACHINE TOOL WORKS
Holland, Mich., U. S. A.

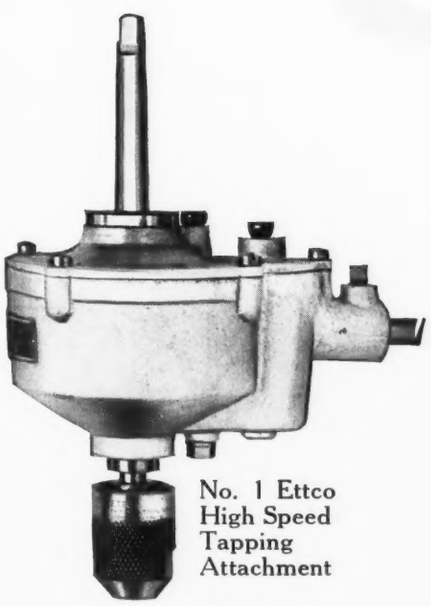
Eight good reasons for using the new Ettco Chucks are:

All ETTCO Drill Chucks take drills 1/64" over capacity of Chuck
ETTCO Chucks increase the value of electric drills.

Cash in your old drill chucks. Send them to us and in exchange for new Ettco Chucks we'll allow 15% off list price which is as follows:

No. 1A Ettco—0 to ¼ in.	$5.50
No. 1½ Ettco—0 to 5/16 in.	6.00
No. 2 Ettco—0 to ⅜ in.	6.50
No. 3A Ettco—0 to ½ in.	9.00
No. 3½A Ettco—⅛ to ⅝ in.	11.00

High Speed Tapping Attachments



No. 1 Ettco High Speed Tapping Attachment

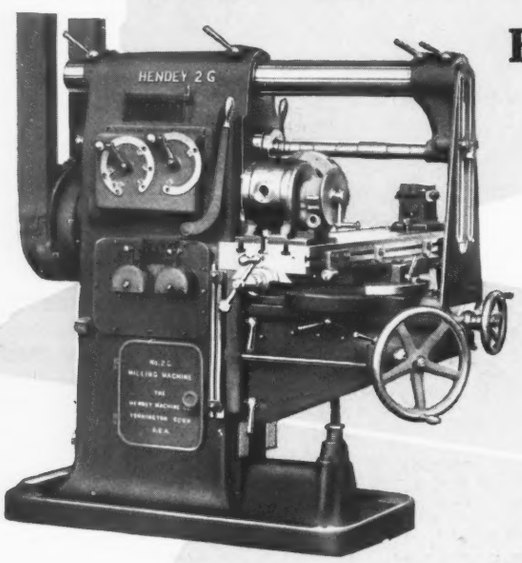
You can do all these things with the Ettco High Speed Tapping Attachment. Cased in Aluminum, it is specially designed for tapping holes up to ¼" diameter. Ettco Tappers increase production enormously, particularly where used with GUN TAP. Put one on your work for ten days—without obligation. Then, if you can spare the Ettco, it may be returned. Capacity to 3/16" in steel, ¼" in cast iron or brass. Price $35.00.

EASTERN TUBE & TOOL COMPANY, Inc.

590 Johnson Avenue, Brooklyn, N. Y.

HENDEY

Hendey Reflections

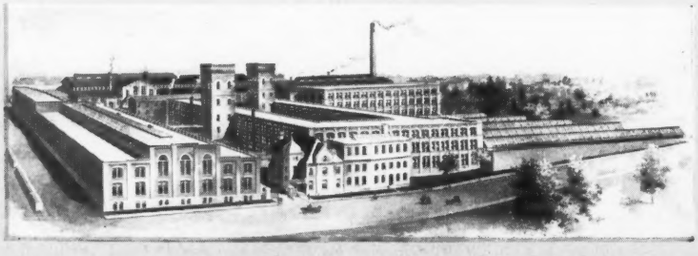


THE HENDEY MACHINE COMPANY
HENDEY
LATHES
SHAPERS
MILLERS
TORRINGTON, CONN.

Modern production standards—that is, modern demands for speed, accuracy and economy in manufacture—make demands on equipment that can only be met by machines especially developed for modern use.

Hendey Machines are in this class. HENDEY NO. 2 G PLAIN AND UNIVERSAL TYPE MILLING MACHINES have every feature that will facilitate production and improve service.

Hendey No. 2 G Milling Machines have 18 progressive spindle speeds, driven through a combination of sliding gears of alloy steel, hardened and heat treated—all controlled by two levers. Speed gear shafts run in ball bearings. Automatic lubrication applied to all bearings and gears in the spindle drives.



THE HENDEY MACHINE CO.
Torrington, Conn., U. S. A.

Singer Bldg., New York City
Commerce Bldg., Rochester, N. Y.
565 Washington Blvd., Chicago, Ill.

This is a No. 7 Newark Spur Gear Cutting Machine

Have you big spur gears to cut? For combined accuracy and speed and economy you can't better the output of Newark Gear Cutting Machines.

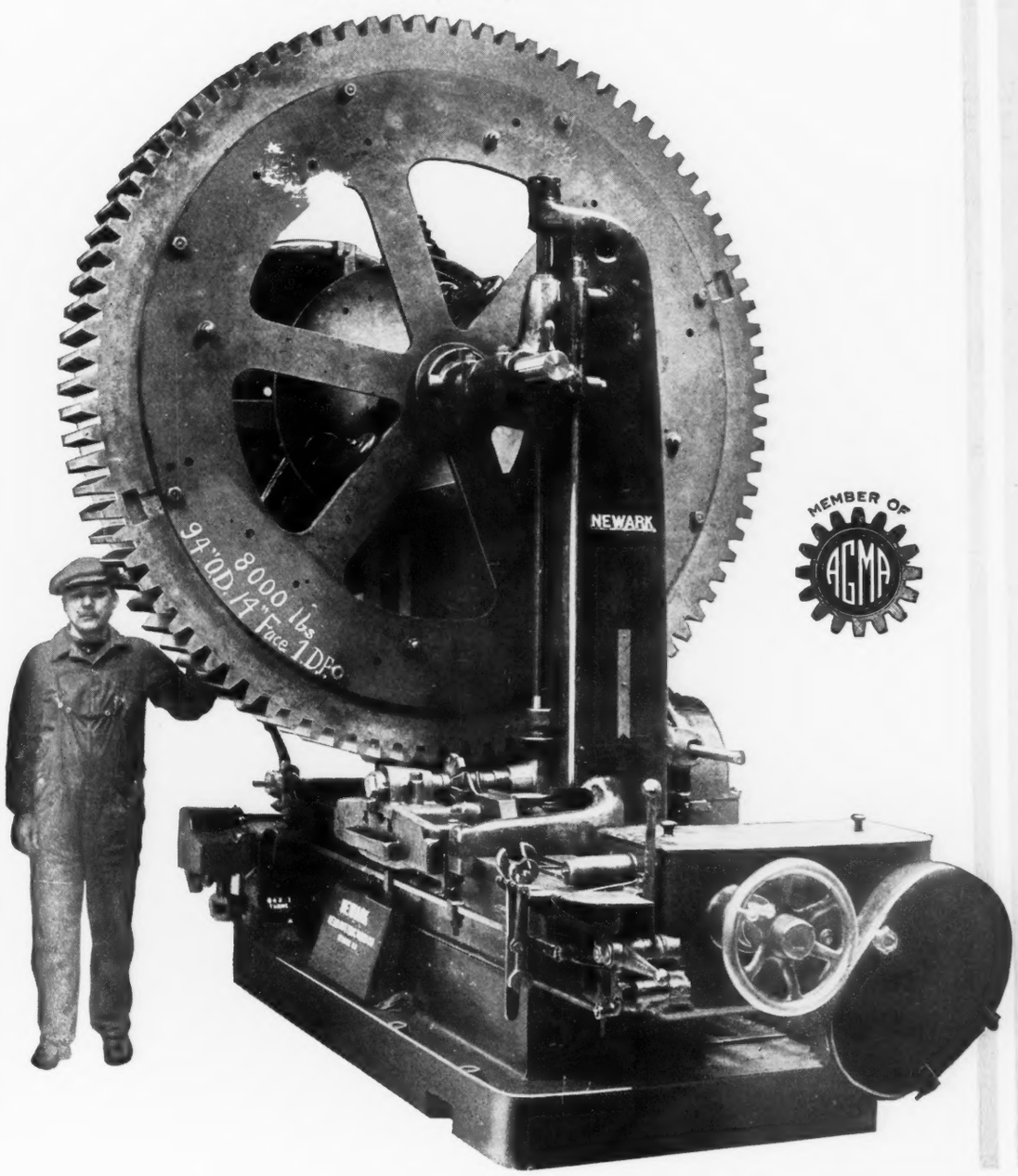
The job shown is a steel ring-gear 1 D.P. It weighs 8000 lbs., outside diameter 94″ and width of face is 14″. The No. 7 Newark is the standard machine for work of this nature. If you have heavy steel spur gears to cut, the No. 7 Newark machine will pay high returns on the investment.

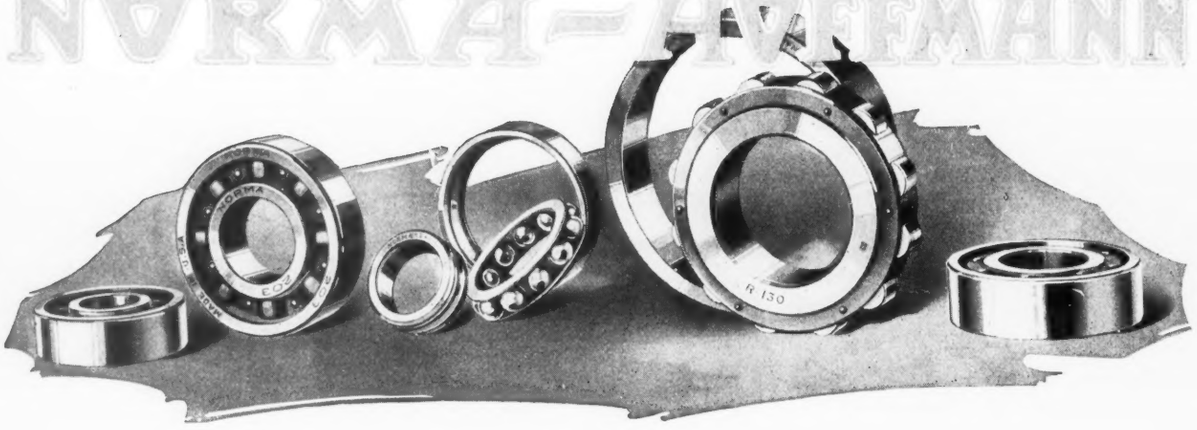
Our Engineering Department has the experience and we are always ready to place our experience at your disposal.

NEWARK GEAR CUTTING MACHINE CO.

HENRY E. EBERHARDT, President.

NEWARK, N. J., U. S. A.





SPEED-ABILITY

LOAD-ABILITY

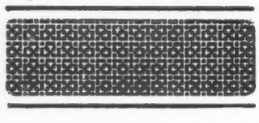
SERVICE-ABILITY

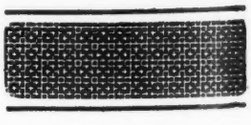
Ask us for the Catalogs

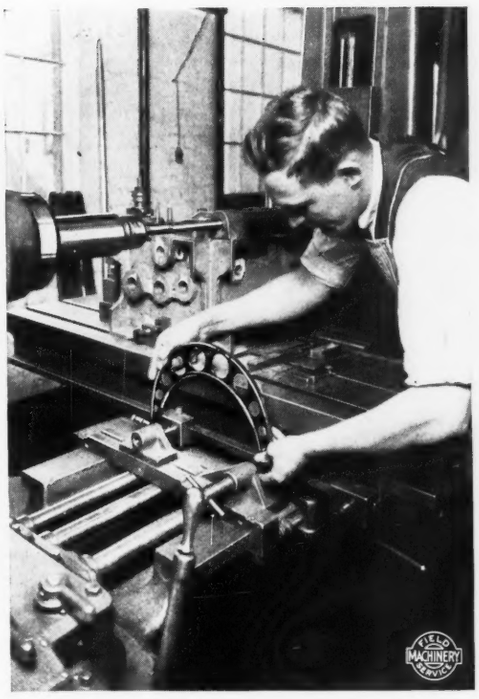
NORMA-HOFFMANN BEARINGS CORPORATION

Stamford—Connecticut

PRECISION BALL, ROLLER AND THRUST BEARINGS







Slocomb Tools

WHETHER for large expensive machines or for small instruments — your dollars should purchase full worth of satisfaction and wear. The return you get on the money you put into Slocomb Tools assures you a full dollar's worth of tool every time.

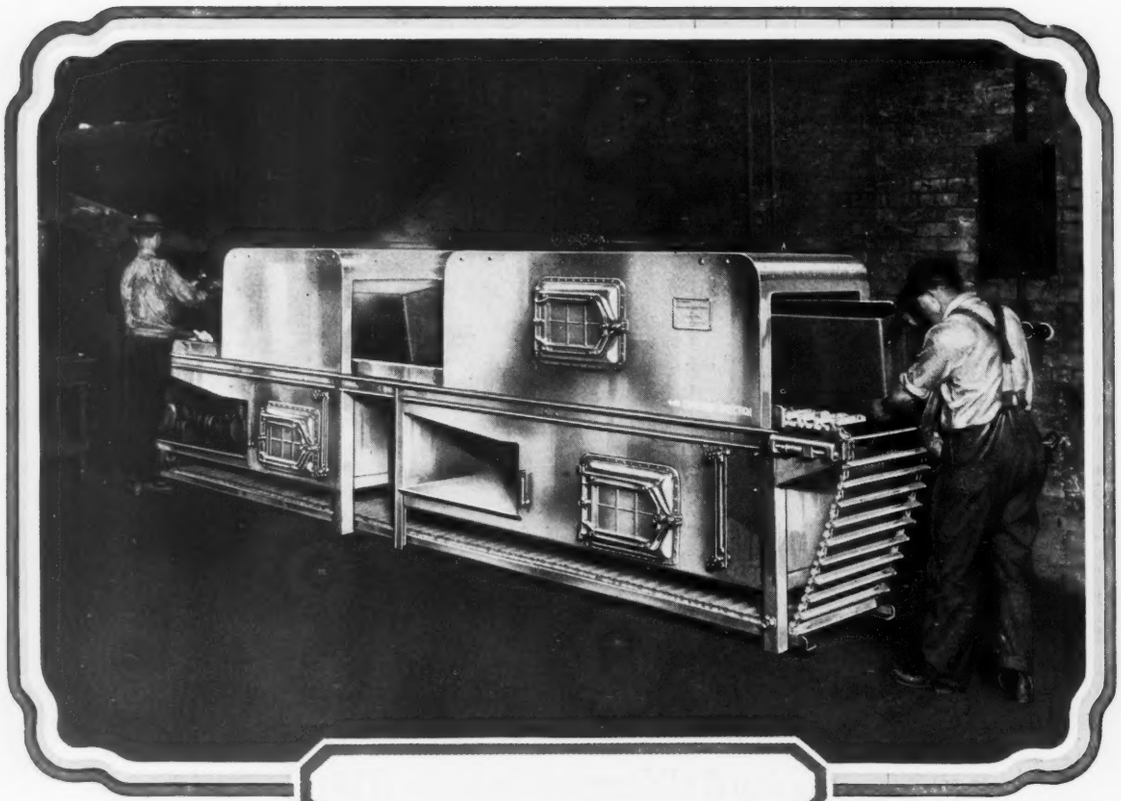
Slocomb Tools are "time tried"—they have been the choice of experienced machinists for over twenty-five years; they are standard in many shops from coast to coast. It's the removable tool steel spindle, accurately fitted — that has given the Slocomb Micrometer the title —"The Longest Lived Micrometer that can be bought."

The Slocomb Center Drill, the original center drill combining drill and countersink of alloy steel, is another tool worthy of the name *Slocomb* which you will find stamped on it.

J. T. SLOCOMB COMPANY,
Providence, R. I.

"—the Longest Lived Micrometer that can be bought"

Slocomb Micrometers and Slocomb Center Drills are made in sizes for every need. Let us send the complete catalog.

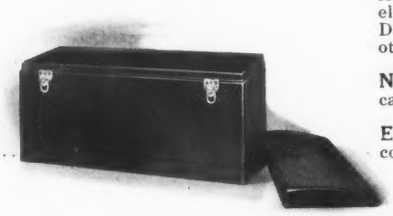


CRESCENT

METAL-CLEANING MACHINES

"Five hours after it was taken from the freight car, our Crescent Cleaning Machine was operating in our plant, and certainly is producing satisfactory results. We are able to do the work with eight less men—a considerable daily saving."

W. C. IRELAND, V. P. & Gen'l Mgr., DETROIT METAL SPECIALTY CORP'N, Makers of IMCO All Steel Automobile Trunks.



THIS IS WHAT THEY WASH

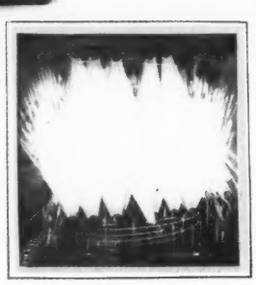
CRESCENT MACHINES ARE CLEANING AJAX motor parts—ATWATER KENT loud speakers—CITROEN fenders—WESTINGHOUSE electrical parts—EDMUNDS & JONES auto lamps—SCHLAGE Locks—NEW DEPARTURE ball bearings—KENNEDY valves—and a great variety of other work in hundreds of famous industries.

NINE STANDARD MODELS, as low as $565 in price. Special models can be built for any cleaning purpose—also to rinse, dry, slush or laquer.

ESTIMATES AND PLANS furnished without obligation. *Write* for complete catalogue and information desired. *Address:*

CRESCENT
WASHING MACHINE CO.
NEW ROCHELLE, N. Y.

THE DOUBLE REVOLVING WASH
An exclusive Crescent feature—the most efficient wash action known



THIS IS WHAT DOES THE JOB

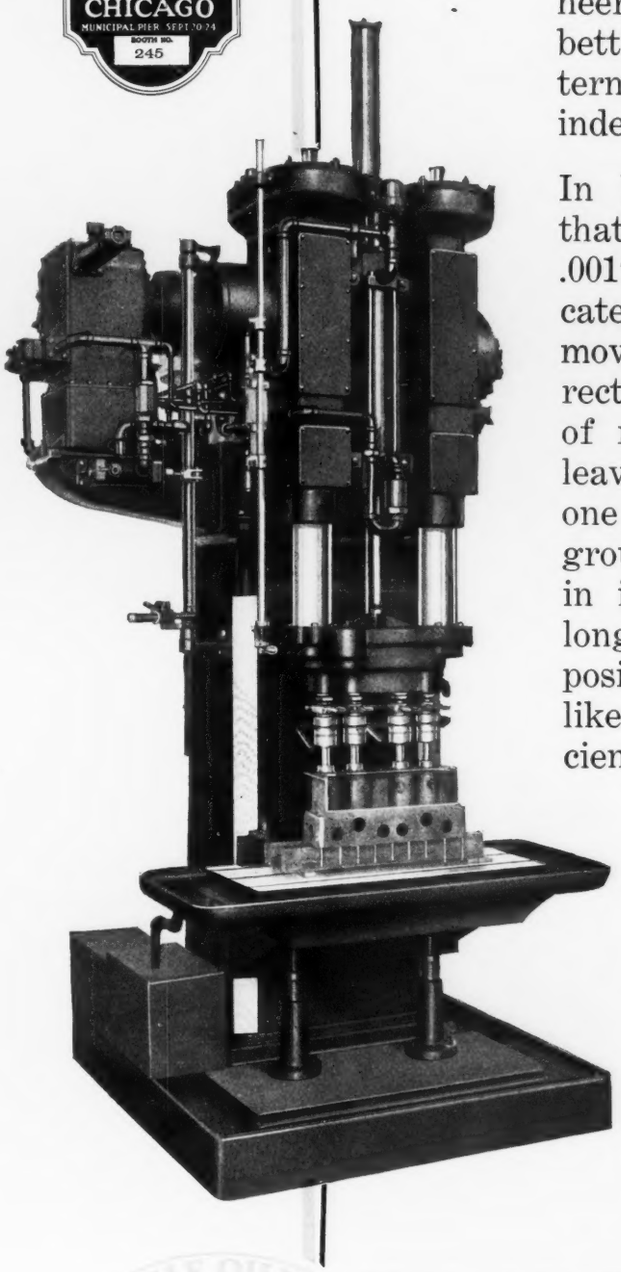
SWIRLING TORRENTS
of boiling hot solution, strip and scrub the work forcefully from every direction

A New—and Better—Way to Finish Cylinders

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20 TO 24
BOOTH NO. 245

Automobile and mechanical engineers agree that honing is not only better but more economical than internal grinding for finishing cylinders.

In honing engine cylinder blocks that have been reamed to within .001″-.002″ our hydraulically reciprocated Cylinder Honing Machines remove all high spots in the bore, correct errors in cylinders reamed out of round or slightly tapering and leave a perfect bearing finish in from one to two minutes. Honing tests in ground cylinders show inequalities in internal grinding; honing with long abrasive stones under spring or positive pressure produces mirror like surface that gives maximum efficiency in service.



The New Self-Oiling All Geared Multiple Cylinder Honing Machine. The two driving spindles are driven by helical self-oiling steel crown gears. Multiple heads of from two to eight spindles are attached to two main spindles running in 5″ diameter guides. Hydraulic cylinder mounted between spindle housings and piston permits vertical travel to 16″—an air cylinder counter-balance operates directly on the main air line.

Send for details of this new method of finishing on Single and Multiple Spindle Honing Machines.

SELF OILING DRILLS ALL GEARED

BARNES DRILL COMPANY

814 Chestnut St., Rockford, Ill.

Production Cylinder Honing Machines

"ADRIANCE"

Pacific Coast Representatives
WATERHOUSE & LESTER CO.
540 Howard Street, San Francisco

BUCK & HICKMAN, LTD.
2 Whitechapel Road, London
Sole Agents for Great Britain

"Adriance" Horning and Wiring Presses are furnished with swinging adjustable bed or with double swinging beds to accommodate dies of various heights. When used for horning, only, they may be equipped with double bumping horns for closing the two corner seams of large square cans with one stroke of the press; or with duplex horns, for hook-forming and side seam setting operations. Mail attached coupon for further information.

ADRIANCE MACHINE WORKS, INCORPORATED

78 RICHARDS STREET, BROOKLYN, N. Y.

Please send copy of "Adriance" Bulletin No. 6.

Name..... Address.....

New Britain Super-Production Automatics

"NEW BRITAIN" NB AUTOMA

Minute Savers! Time Clippers! Production Pace-Makers!

WE WILL EXHIBIT
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CHICAGO
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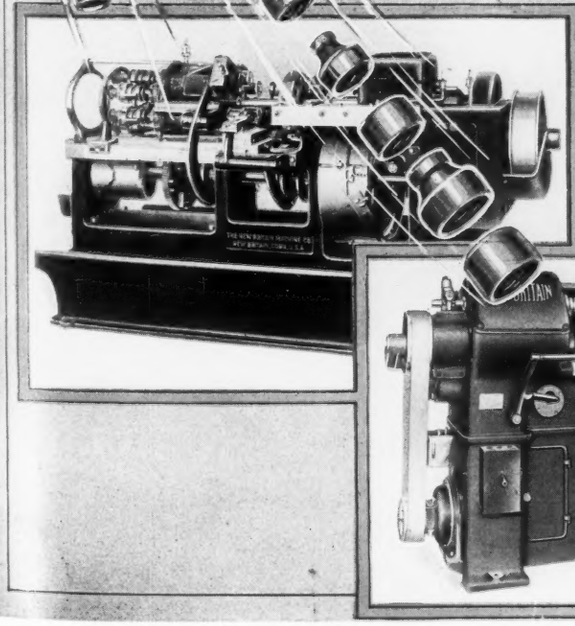
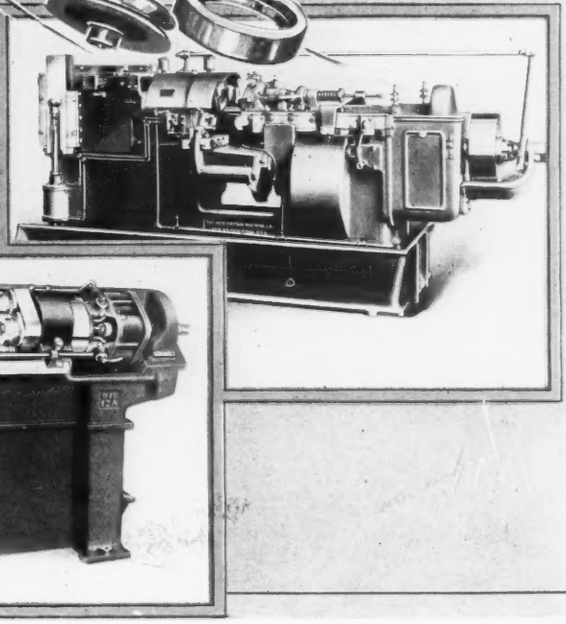
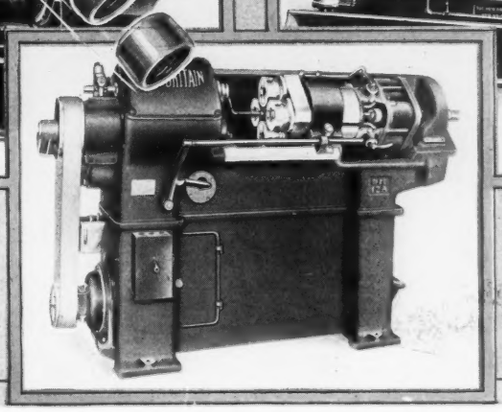
The New Britain Machines are super-producers, keeping costs down. The accuracy you want is there, whether it be on Six Spindle Automatic Screw Machines; Tool Rotating Automatic Chucking Machines (with Air Chucks); or Work Rotating New-Matic Chucking Machines (with Air Chucks).

The New Britain Machine Co.
New Britain, Conn.



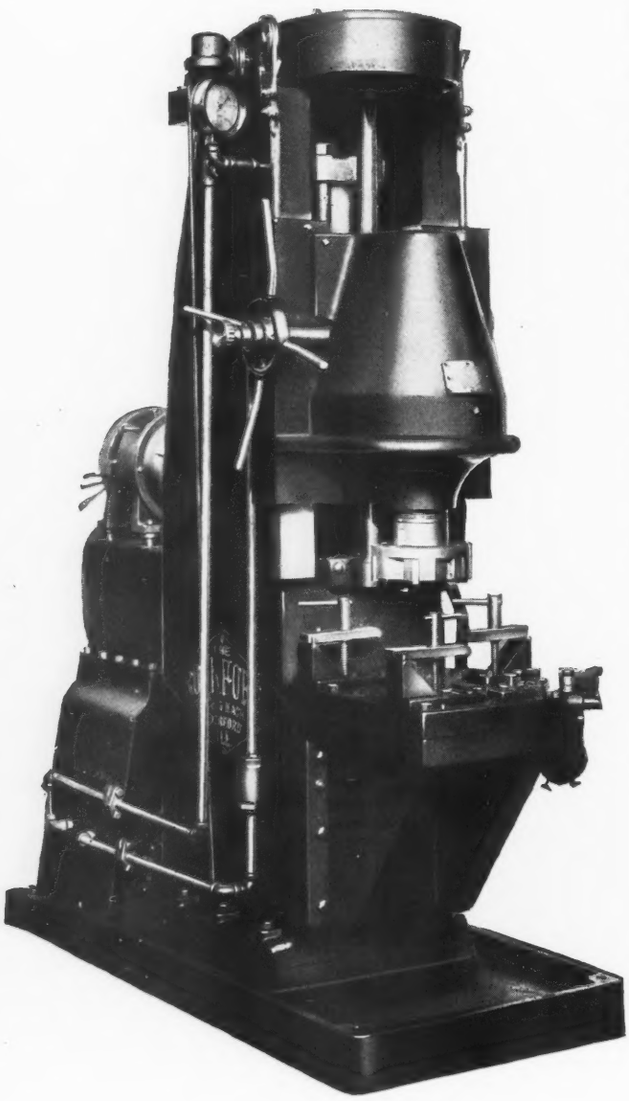




ROCKFORD

VERTICAL HEAVY DUTY
DRILLING MACHINE

Designed with Power —Built for the Job



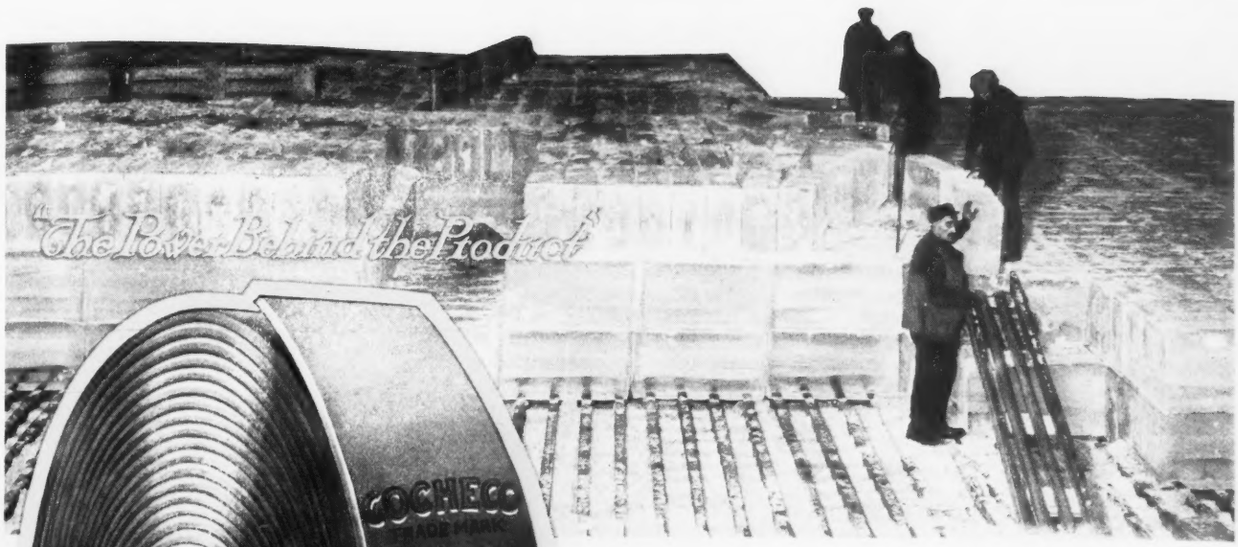
Speed on heavy work, rigidity, accuracy and convenient operation make heavy drilling and boring with the New Rockford Heavy Duty Drill a highly profitable piece of production equipment.

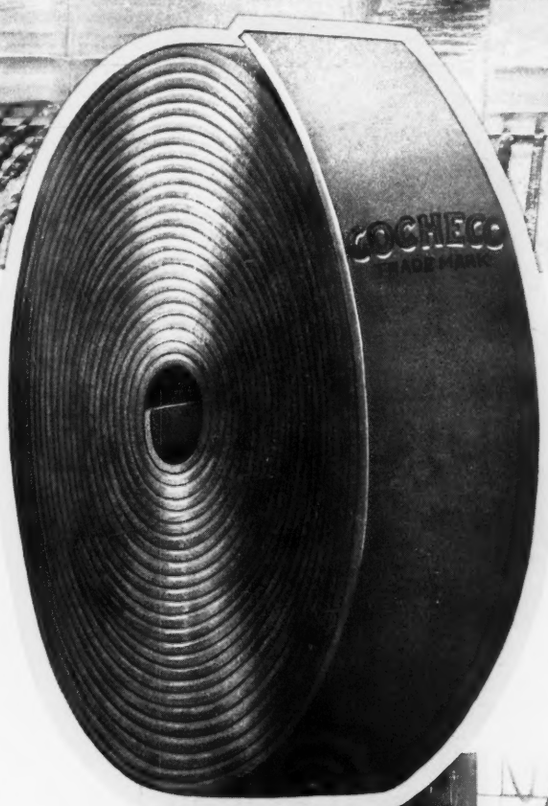
Arranged for motor drive through pick-off gears for obtaining speed changes; spindle head operates on ways on front of column, is fed by oilgear feed and can be made to carry several spindles for multiple drilling operations.

Details of the New Rockford will give you new standards for drilling machine construction.

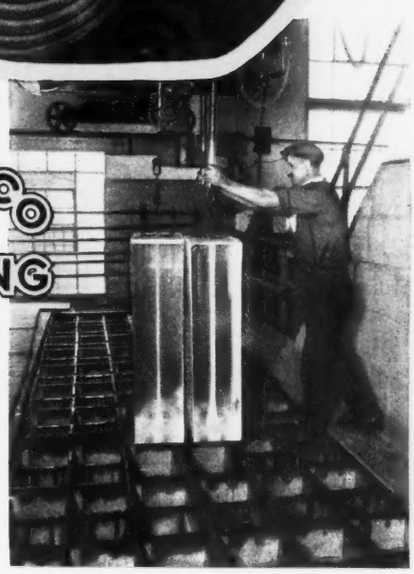
Rockford Drilling Machine Company

Rockford, Ill., U. S. A.





COCHECO
BELTING



"Cocheco"

Keeps You Cool

When the dog days are on us and the city swelters in the broiling sun, it is the man made "arctic circle" in the big ice plant that saves the lives of thousands, brings summer comfort to millions of people.

Manufactured ice—clean ice made from filtered water—is a scientific achievement that has created a great modern industry with carefully specialized and highly developed equipment.

Machines built to stand the deteriorating effect of atmosphere and temperature are driven by **Cocheco Belts,** "the machine belt for the ice belt" because of its quality and durability.

Leather carefully selected, correctly treated makes the belts that give best service—**Cocheco Belts**

Ask for the Cocheco Booklet with Cocheco Facts

I. B. Williams & Sons, Dover, New Hampshire, U. S. A.

fast!

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
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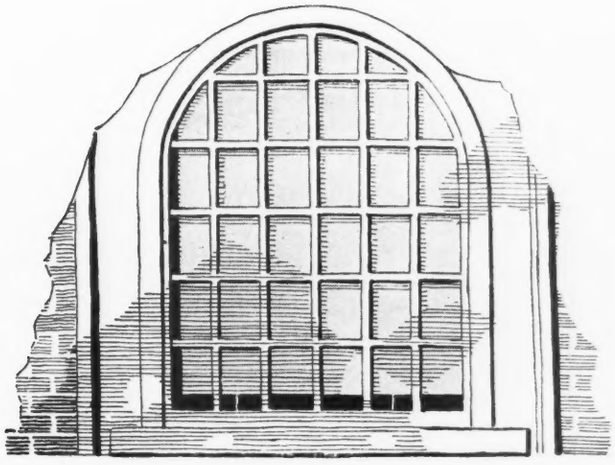
Are you one of the manufacturers who is taking advantage of the fast production special form cutters, or are you still employing several single cutters to complete one operation?

Send us your blue prints of special form parts and let us show you how we can cut your production cost and increase your output.

Don't fail to visit our bigger and better exhibit in booth 164 at the NATIONAL STEEL AND MACHINE TOOL EXPOSITION, Municipal Pier, Chicago, September 20-24. Our Engineers will be glad to explain the merits of MICHIGAN TOOLS.

MICHIGAN TOOL CO.
Detroit, Mich.

Branch Offices in All Principal Cities



"When we lift the dark shades from our windows, we let in more light than we let out"

MANUFACTURERS used to keep their machines and methods behind locked doors and shaded windows. They objected to visitors who might be spies for competitors. If they developed something new and good, they hid it as a miser buries gold in the ground.

But the light has come to them. They have found that they had no monopoly on good ideas—that others could bring as well as take away. So that now the modern manufacturer throws his plant wide open and exchanges ideas for the good of everybody.

We approve this heartily. Our doors are open to all. Our laboratories and men are available for any purpose for which we can consistently offer them.

If you are working out a new idea in your own business that demands new machine tools, let us worry about the machine tool end of the problem. We have all the facilities in our various plants. We have men who know every angle of machine tool making—who have wiped out the "it-can't-be-done" barrier so many times during the past half-century that their experience might save thousands of dollars' worth of experimenting.

Come and see us. We cannot make our invitation strong enough, to tell you how much we believe this open door policy can mean to all of us in developing more and better production.

Let us send a man to your plant to make a study of your machine tools and tell you plainly if there is anything we make or can make that would save you an appreciable amount of money annually.

Niles-Bement-Pond Company, 111 Broadway, New York

Divisions of NILES-BEMENT-POND COMPANY

THE NILES TOOL WORKS COMPANY, *Hamilton, Ohio*
RIDGWAY MACHINE COMPANY, *Ridgway, Pa.*

NILES GEAR COMPANY
111 Broadway, New York

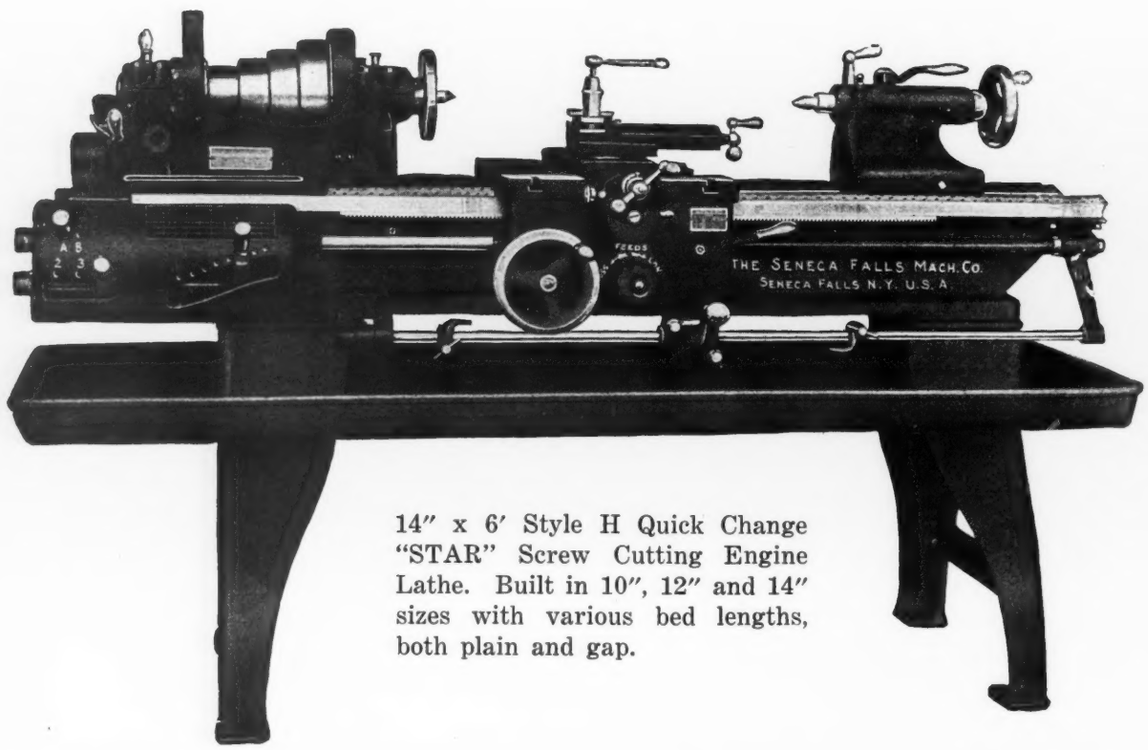
PRATT AND WHITNEY COMPANY, *Hartford, Conn.*
NILES CRANE CORPORATION, *Philadelphia, Pa.*

You Can Count on a "Star" Every Time

A sturdy, dependable Engine Lathe—the Star—with tool room accuracy, power and endurance, ample for all demands, plus the simplicity and convenience of operation which 50 years of experience as small lathe specialists have developed.

The built in accuracy of Star Lathes is known the world over.

Seneca Falls Lathes are equal to any turning problem within their range—send for catalog.



14″ x 6′ Style H Quick Change "STAR" Screw Cutting Engine Lathe. Built in 10″, 12″ and 14″ sizes with various bed lengths, both plain and gap.

SENECA FALLS MACHINE COMPANY, Seneca Falls, N. Y.

Manufacturers of Seneca Falls Cost Cutting Turning Equipment

"Red Shield" HIGH SPEED DRILLS

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ervice

STANDARD TOOL CO.

The Shield Appears on All Our Drills

THE STANDARD TOOL CO.

CLEVELAND

New York: 94 Reade St. Chicago: 552 W. Washington Blvd.

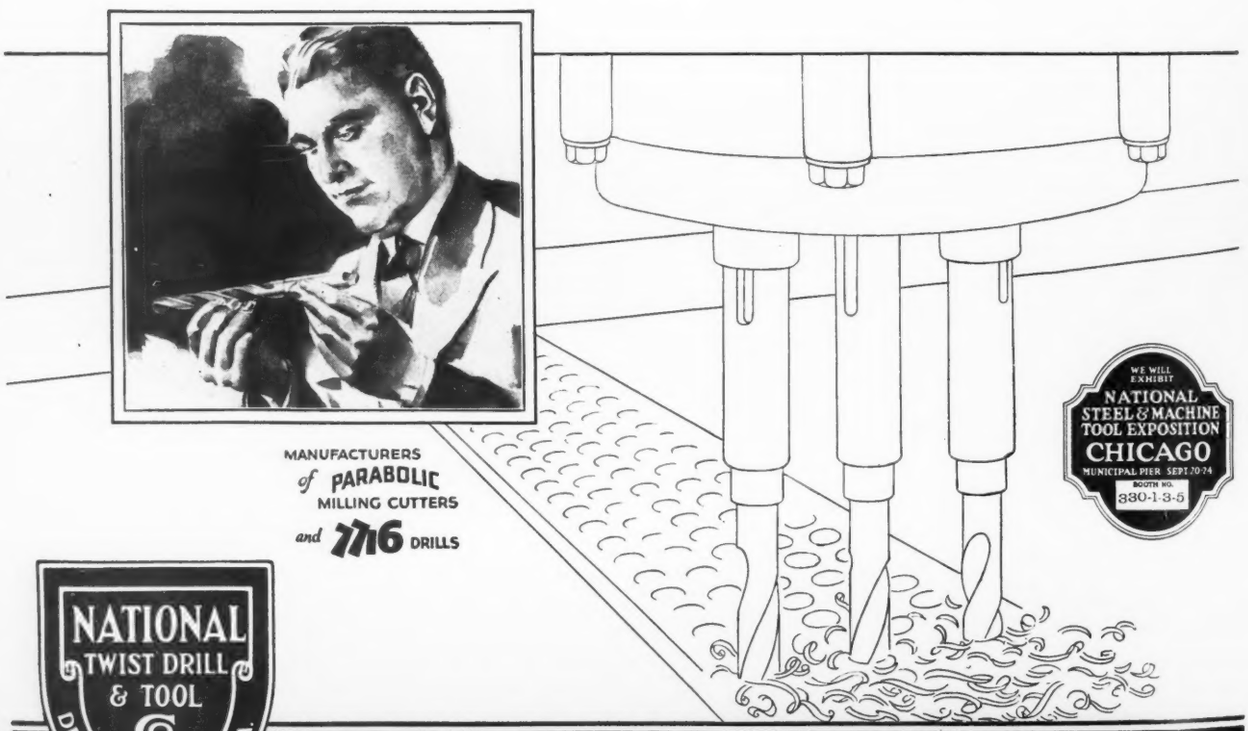
Fredk. Pollard & Co., Ltd., London and Leicester—England
Paris, France—Burton Fils Copenhagen, Denmark—Nienstaed & Co.

A Typical National Performance

24,000 Holes
And Good *for* That Many More

This is the report, from a large Pacific Coast Engineering Corp. Using three National 7716 H.S. Drills in a Multiple Spindle, at .007 feed and 280 speed, each drill has bored 24,000 holes in Header Plates and is not half used up. Further reports show that ¾ inch steel tubes are rolled into these holes without any reaming operation and the joints are steam tight. Unsurpassed for Speed—Strength—and Durability

It Pays To Insist On National Twist



NATIONAL TWIST DRILL & TOOL CO. DETROIT U.S.A.

Dealers Everywhere

TWIST DRILLS - REAMERS - HOBS - MILLING CUTTERS - SPECIAL TOOLS

NATIONAL
TWIST DRILL AND TOOL COMPANY
DETROIT, U.S.A.

Worm Drives

For

Automobiles
Speed Reducers
Elevators, Etc.

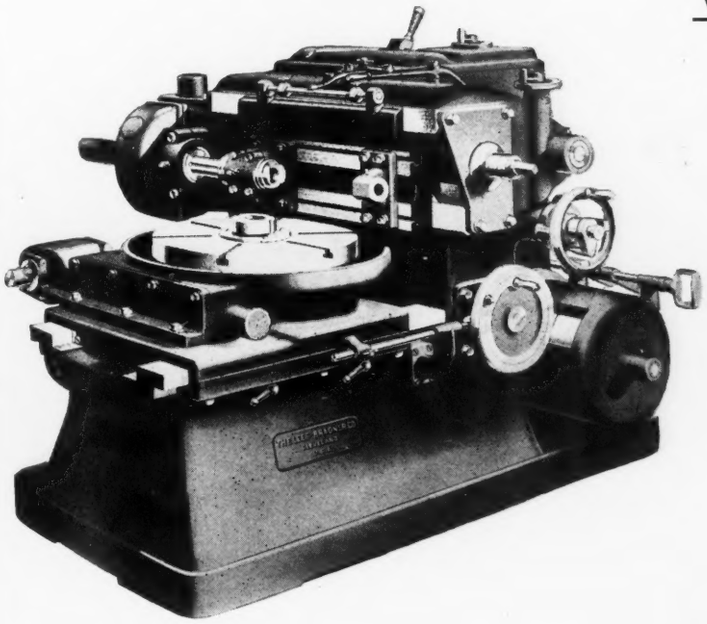
As general interest in Automobiles with WORM DRIVEN AXLES is rapidly increasing, every live Engineer is investigating manufacturing equipment for the most efficient production of the Worms and Gears...

The L-B No. 9 WORM GEAR GENERATORS and related THREAD MILLERS embody the results of MANY years' experience in the engineering fundamentals involved and Production Managers can turn to LEES-BRADNER with complete confidence.

LEES-BRADNER

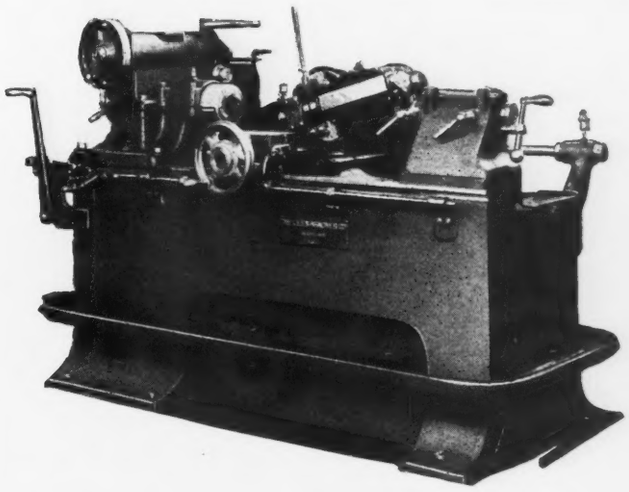
Worm Gear Generators

Worm Thread Millers



No. 9 Worm Gear Generators
designed especially for low cost quantity production. Accurate, fast, compact and capable.

Worm Thread Millers
Exceptionally efficient and extremely accurate. . . Capacity up to 2½" normal circular pitch; single or multiple thread.



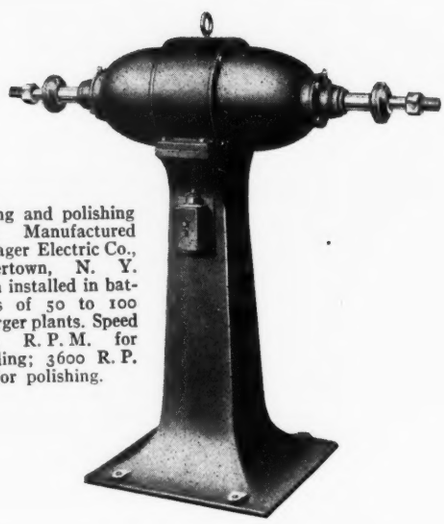
The LEES-BRADNER Engineering staff is ready to collaborate with you on any gearing problem and will gladly offer suggestions or recommendations...

Write, wire or phone or, better still, talk it over with our representative who is also at your service without obligation.

The LEES-BRADNER Co.

CLEVELAND, OHIO, U. S. A.

The new Super-Strom deep-grooved without filling slots



Buffing and polishing lathe Manufactured by Eager Electric Co., Watertown, N. Y. Often installed in batteries of 50 to 100 in larger plants. Speed 1800 R. P. M. for grinding; 3600 R. P. M. for polishing.

A real test for ball bearings

In this buffing and polishing lathe the Strom Bearing is given another opportunity to demonstrate its true value. The hundreds of these machines that are so dependably serving foremost industries require bearings of microscopic dimensional accuracy and eccentricity — requirements that the Strom Bearing has a recognized ability to fulfill.

Speed, too, is a factor. For when these machines are used for polishing they are equipped with motors that run at 3600 R.P.M. Moreover, while rotating at this terrific speed they are subjected to uneven thrust and radial loads as the operator forces his work against the polishing wheel at all angles.

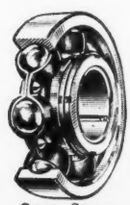
Strom Bearings were selected by the manufacturers of these lathes for the same reasons that they are being chosen by hundreds of other manufacturers — because they represent precision, uniformity, and maintained quality in unsurpassed degree. Write for catalog and engineering data.

Single-acting thrust bearing, flat seats (Grooved races) 1100-F Series

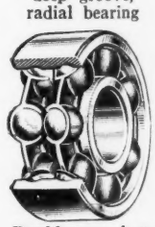
Double-acting thrust bearing, flat seats (Grooved races) 2100-F Series

Single-acting, self-aligning thrust bearing, levelling washer, 1100-U Series

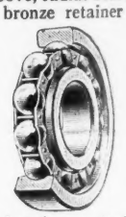
Double-acting, self-aligning thrust bearing, levelling washers 2100-U Series



Super-Strom deep groove, radial bearing



Double-row, deep-groove, radial bearing bronze retainer



Angular contact bearing, combination radial and thrust

Adapter type bearing, with sleeve

Strom BALL BEARINGS

40

STROM BEARINGS CO., 4563 Palmer St., Chicago, Ill.

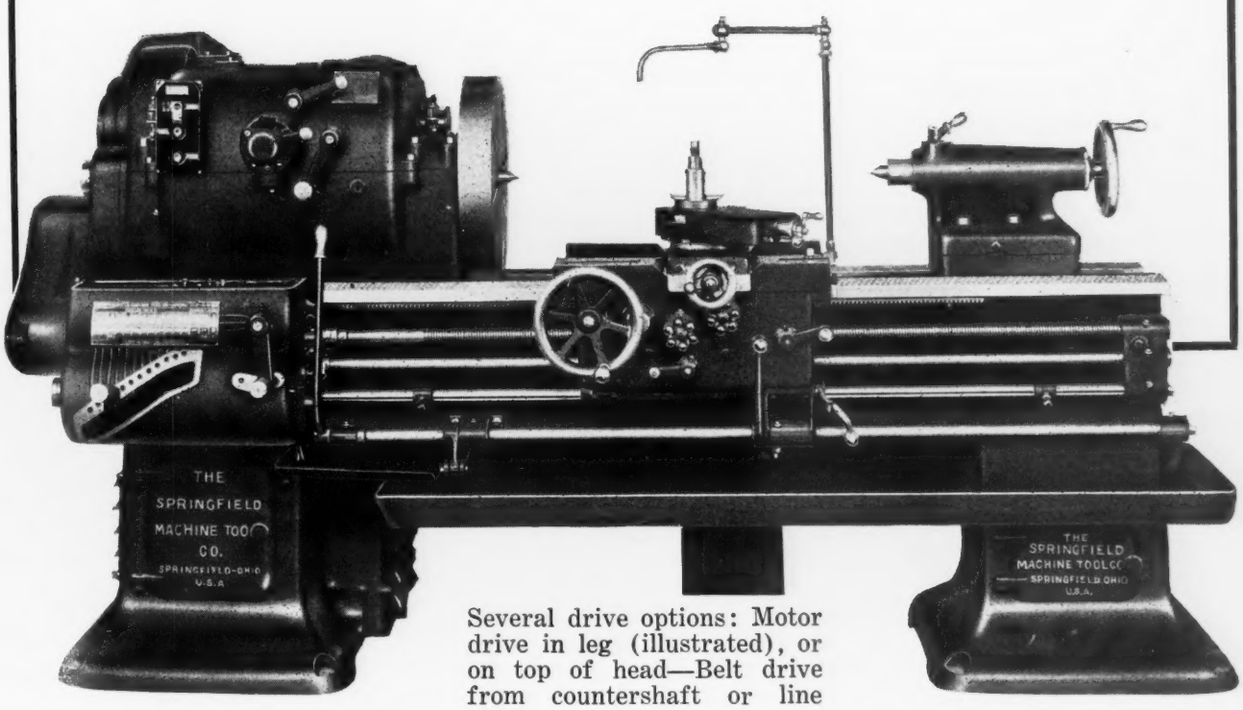
SPRINGFIELD
Ball Bearing Geared Head
ENGINE LATHES

These are the latest additions to the Springfield Line of Lathes—Machines which embody time-tested features for convenient and economical operation —that guarantee the superior performance critical mechanics have come to expect of Springfield products.

All journals except spindle (including thrust collar) are ball bearing; spindle journals are adjustable for wear. Adjustments can be made without removing cover or caps. Spindle is 60 point carbon steel. Twelve selective speeds with fourteen drop forged heat-treated gears running in oil, seven gears in train. *Idle gears not in mesh.*

The operator has the machine and work always under instant and easy control. Both in accuracy and ability to turn out the work at lowest cost, the new Springfield Geared Head Lathe will more than measure up to your most exacting demands.

Let us send folder with complete description.



Several drive options: Motor drive in leg (illustrated), or on top of head—Belt drive from countershaft or line shaft.

THE SPRINGFIELD MACHINE TOOL CO.

Manufacturers of Springfield Lathes and Shapers

631 Southern Avenue **SPRINGFIELD, OHIO, U. S. A.**

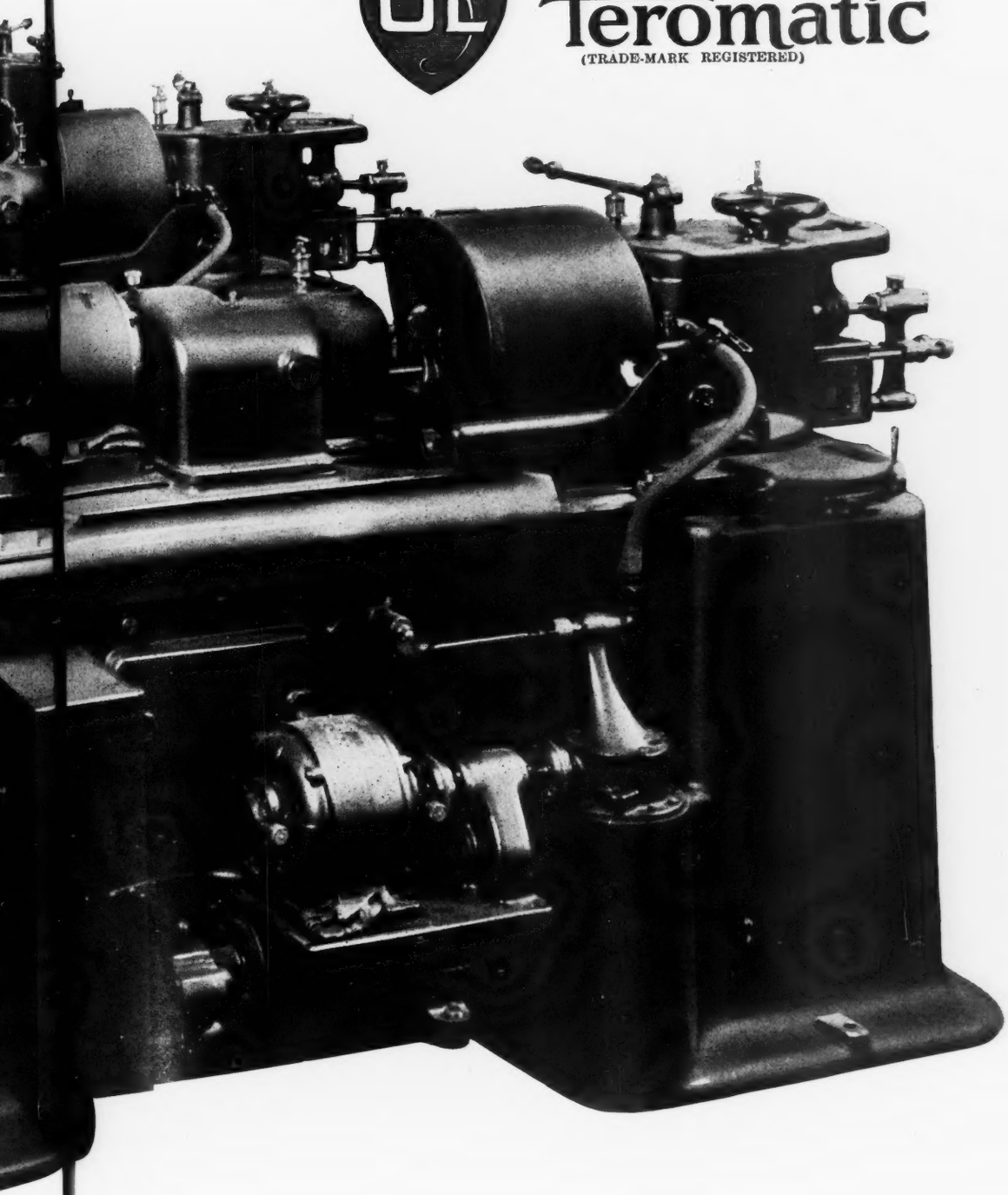
A Recent Shipment t

GIDDINGS & LEWIS

FOND DU LAC, W

t to the "Motor City"

G&L Teromatic
(TRADE-MARK REGISTERED)



S MACHINE TOOL CO.

LAC, WISCONSIN, U. S. A.

Cleveland Automatics

Production Units that Reduce Costs

The 5½ Inch Heavy Duty Model A "Cleveland"

The right "Cleveland" is bound to be profitable. Proof of this is clearly shown in the case of one manufacturer who keeps in continual use an installation of *fifty* "Cleveland" Automatics. He contracted to do a special production job on commutator shells and his first action upon receipt of the order was to install a 5½ inch Heavy Duty Model A "Cleveland"—a machine he knew to be especially fitted for the work. This is the confidence of all "Cleveland" users—they know the make to be *profitable.*

Variable Spindle Speed Automatic Electrically Controlled "Clevelands" step up the spindle speed and reduce as the various tools work, increasing the output, producing finer finish, and increasing the life of the cutters.

Eight forward spindle speeds are available on "Clevelands" from 4½" to 7¾" capacities.

Cleveland Models—Multiple or Single Spindle—are recommended by our engineers to meet your need. Send blue prints of your work to "Engineering" at our plant.

We are exclusive builders of "Cleveland" Automatic Machines

The Cleveland Automatic Machine Co.

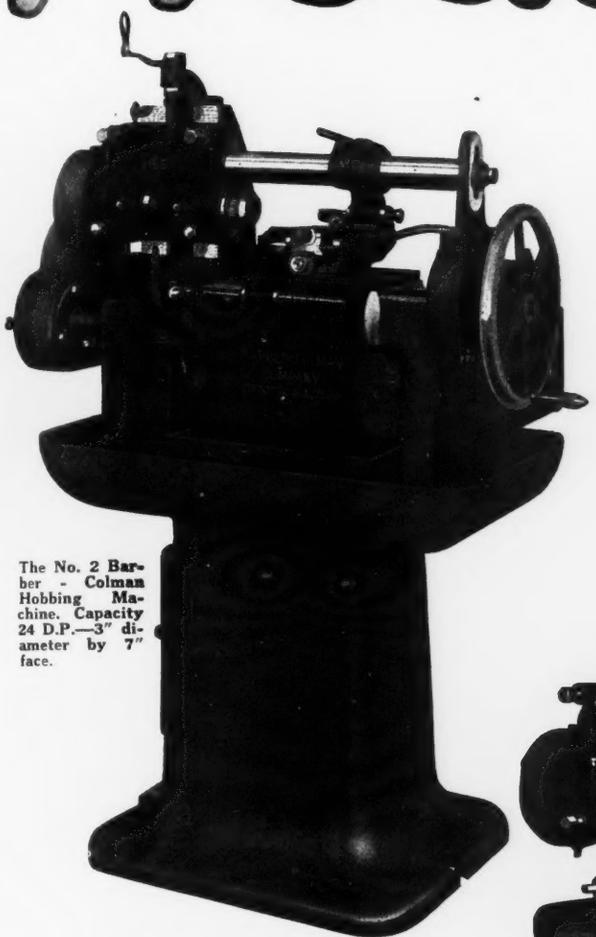
CLEVELAND, OHIO, U. S. A.

NEW YORK
95 Liberty St.

DETROIT
1217 Book Bldg.

CHICAGO
565 W. Washington St.

Producers



The No. 2 Barber - Colman Hobbing Machine. Capacity 24 D.P.—3" diameter by 7" face.

The No. 2 and No. 3 Barber-Colman Hobbing Machines are built with all the refinements of the larger No. 12 machine and have long since proved their efficiency in producing hobbed forms of the highest quality for

Typewriters
Cash Registers
Phonographs
Speedometers
Adding Machines
Fishing Reels
Sewing Machines
Fare Registers
Electrical Devices
Scales
Cream Separators
Automobiles
Automatic Telephones
Meters, and numerous other products.

If you have work up to 5" diameter, that can be hobbed, the No. 2 and No. 3 Barber-Colman Hobbing Machines are of interest to you. Send samples for production estimates. No obligation. Complete information on Barber-Colman products on request.

Capacity 12 D. P.—5" diameter by 7" face.

BARBER-COLMAN PRODUCTS

Hobbing Machines
Hobs
Hob Sharpening Machines
Milling Cutters
Tapping Attachments
Universal Vise Chucks

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
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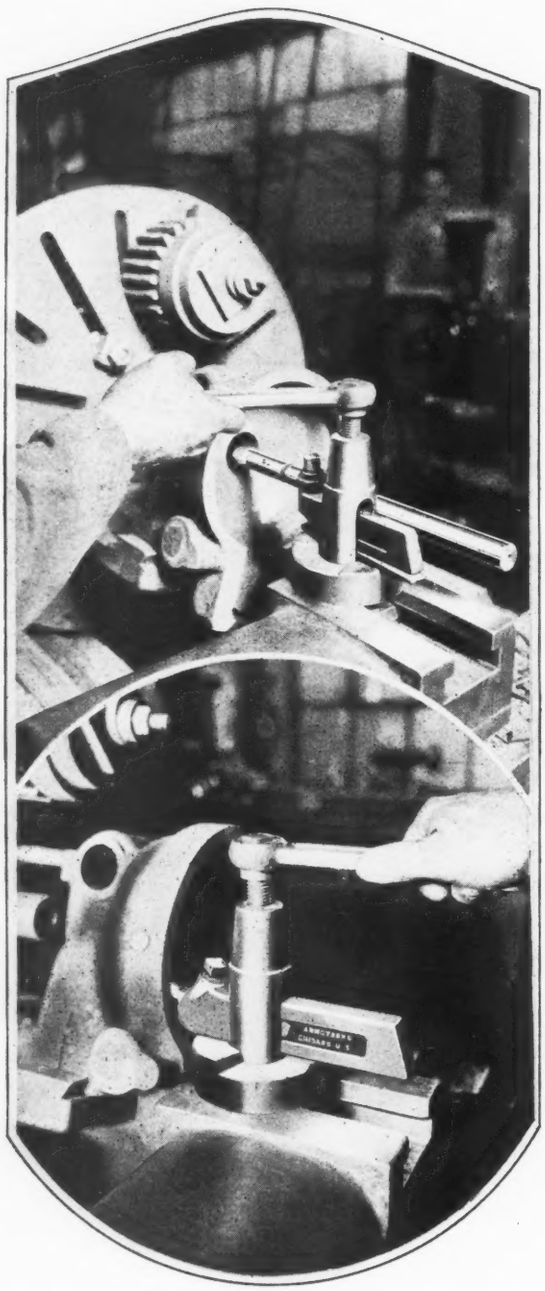
BOOTH NO. 338

BARBER-COLMAN COMPANY

General Offices and Plant

Rockford. Ill., U. S. A.

ARMSTRONG



Tool Holders in the AVEY DRILLING MACHINE CO.'S Plant

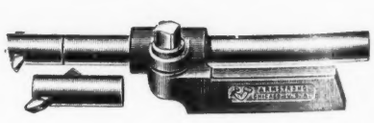
More than forty Armstrong Tool Holders have been in daily service in this plant for nearly fifteen years. Yet, today, these tools can be depended upon to perform as smoothly and as accurately as the day they were purchased. That's service!

When using Armstrong Tool Holders, there is no wasting of time or tool steel. Then too, they do not chatter or vibrate under heavy loads, assuring the maximum accuracy. That's why *men who know tool costs* use Armstrong Tool Holders.

Let us send you our Catalog—it may help you solve your cutting tool cost problem.

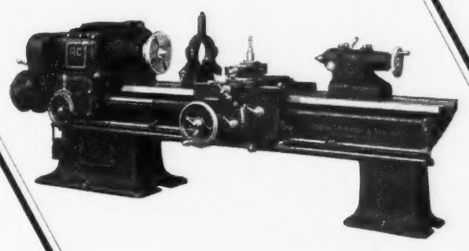
For best results use Armstrong Tool Bits

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
313 N. Francisco Ave., Chicago, Ill., U. S. A.



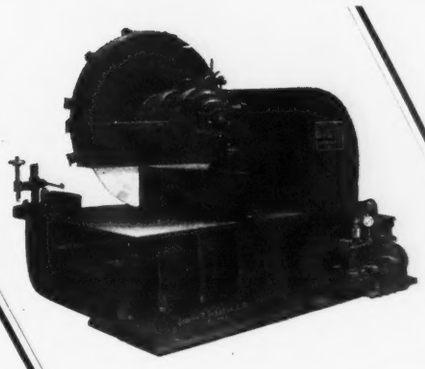
Headquarters for Machine Tools and Metal Working Equipment

We carry a complete line of Machinery, including everything from a small electric drill up to the heaviest metal-working equipment. Our experienced engineers, familiar with all phases of the metal-working industry are always at your service to help with any of your equipment problems. If you need Machinery, call on Ryerson.



The Ryerson-Conradson Lathes have many outstanding features. The Herringbone Gear Drive to the spindle assures smooth, even transmission of power resulting in smooth, clean work, free from chatter marks.

The bed and head are a single casting giving great rigidity. Centralization of controls saves the operator's time and permits more careful work. Send for Bulletin No. 1,301 which describes them fully.



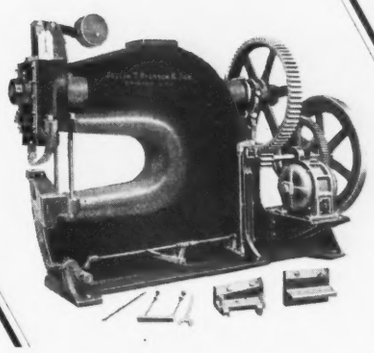
Recent time studies on actual production have proven the Friction Saw Method of cutting bars and shapes, not only faster but cheaper than cutting with any other type of equipment.

It has a decided advantage in that varying sizes and shapes of material can be cut in immediate succession as there are no blades or attachments to be changed. Bulletin No. 9001 will give you complete information. Ask for it.

RYERSON MACHINERY PARTIAL LIST

- Lathes
- Drills
- Planers
- Shapers
- Punches
- Shears
- Motors
- Bulldozers
- Small Tools
- Friction Saws
- Bevel Shears
- Milling Machines
- Power Hammers
- Horizontal Drilling and Boring Machines
- Bending Rolls
- Pneumatic Machinery
- Serpentine Shears
- Hydraulic Machinery
- Spring Shop Equipment
- Flue Shop Equipment

Nationally known firms are using Ryerson-Kling Punching Machines and are buying additional equipment of the same make. They have found, that year in and year out these punches produce more holes with little or no time out, less upkeep and fewer repairs. Send for bulletin 11,066 which tells the whole story.



Send for Complete Catalog

JOSEPH T. RYERSON & SON INC.

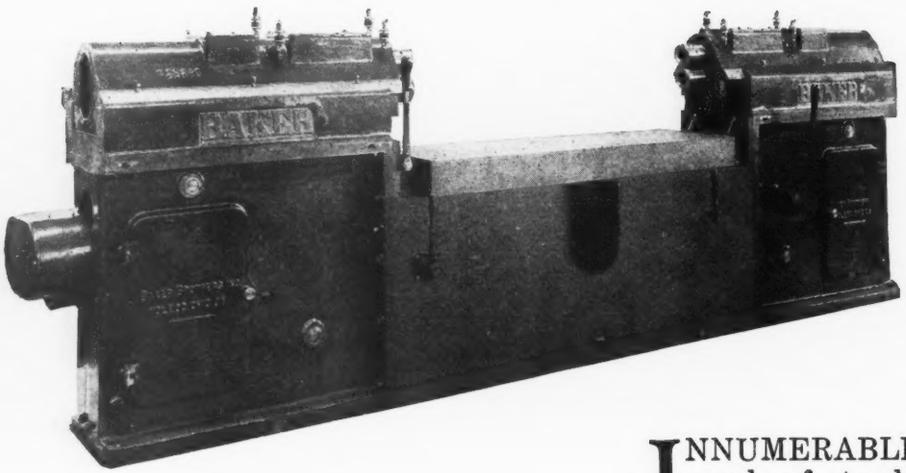
Established 1842

Plants: CHICAGO MILWAUKEE ST. LOUIS CINCINNATI DETROIT BUFFALO BOSTON NEW YORK
Branch Offices: Minneapolis Louisville Denver Tulsa Houston Los Angeles San Francisco

RYERSON MACHINERY

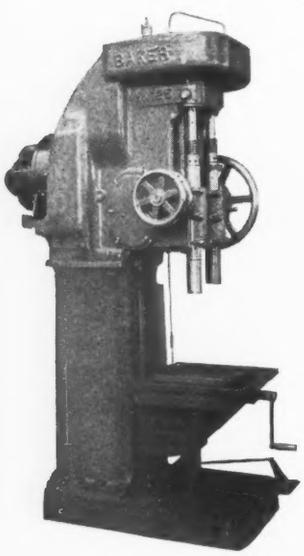
BAKER

for Drilling and Boring



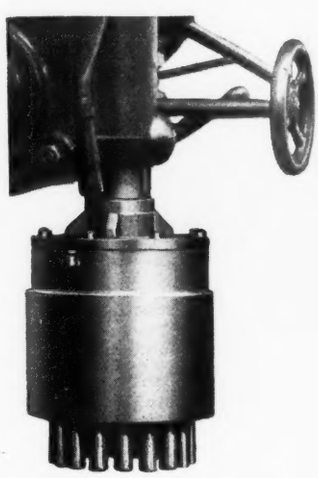
INNUMERABLE modifications can be made of standard Baker machines for specific operations where accuracy and a high output are prime considerations. Standard equipment is offered both vertical and horizontal, single and multiple spindle.

No. 3 Duplex, *cam feed*, automatic boring machine, with special 2 spindle heads for boring transmission cases. The No. 3 Baker Duplex can be furnished with single or multiple spindles, and the center section can be varied as to width and length to accommodate a wide range of work and fixture design. The design and construction insure unusually accurate alignment between the two ends.



No. 125—2 Spindle Drill. Center distance made special for customers' requirements. Spindles feed simultaneously but can be adjusted vertically relative to each other. Machine used with plain or indexing table.

Baker Multiple Head, made special for specific operations. Hardened gearing, ball bearing mounted, spindles with or without vertical adjustment. Furnished for any make machine. When used on Baker machines, attached by patent flanged quill construction.



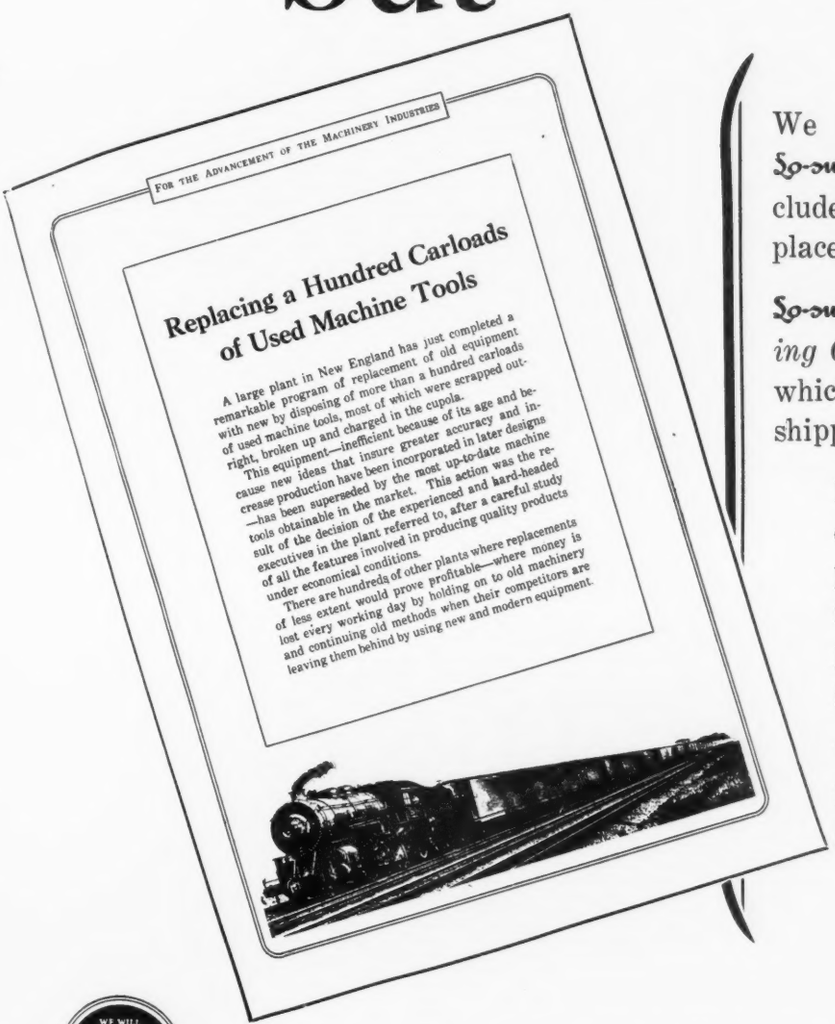
We would welcome the opportunity of being allowed to show you what BAKER equipment could produce on your work

BAKER BROTHERS, Inc., Toledo, Ohio, U. S. A.

Builders of drilling, boring, tapping, keyseating and slotting equipment

We are not Replacing obsolete Equipment to the tune of a hundred Carloads

but


For the Advancement of the Machinery Industries
Replacing a Hundred Carloads of Used Machine Tools
A large plant in New England has just completed a remarkable program of replacement of old equipment with new by disposing of more than a hundred carloads of used machine tools, most of which were scrapped outright, broken up and charged in the cupola.
This equipment—inefficient because of its age and because new ideas that insure greater accuracy and increase production have been incorporated in later designs—has been superseded by the most up-to-date machine tools obtainable in the market. This action was the result of the decision of the experienced and hard-headed executives in the plant referred to, after a careful study of all the features involved in producing quality products under economical conditions.
There are hundreds of other plants where replacements of less extent would prove profitable—where money is lost every working day by holding on to old machinery and continuing old methods when their competitors are leaving them behind by using new and modern equipment.

We are proud to say that So-swing Equipment was included in the Machines that replaced these 100 carloads.

So-swing *always reduces Turning Costs*—that's the basis on which they are bought and our shipping department is *Busy*.

Even if you can't replace one hundred carloads of profit REDUCING equipment in one slap, you probably can and ought to go part way.

Will you send us your Blue Prints or shall we send an engineer?

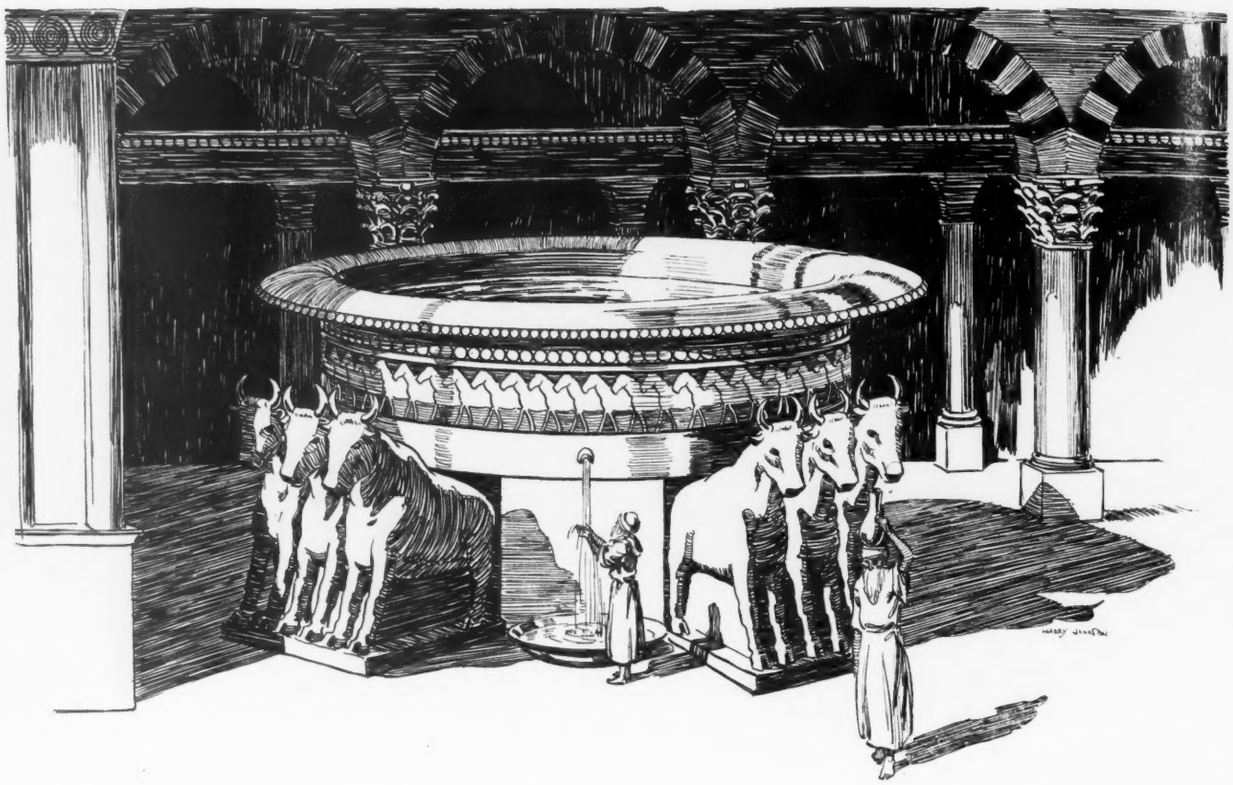
WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20 '24
BOOTH NO.
402

Why not take a walk through your lathe department and see if any old time engine lathes are keeping your costs high.

SENECA FALLS MACHINE COMPANY

SENECA FALLS, N. Y.

Manufacturers of Seneca Falls Cost Cutting Turning Equipment



Brass—The Wisdom of Solomon

WHEN the craftsmen of Israel built their ancient temple, King Solomon caused to be erected for the water a giant bowl of brass, measuring 9 feet high and nearly 18 feet from brim to brim.

Solomon's wisdom in selecting brass as the best rust resisting metal for his purpose is unquestioned even today, with 3000 more years' experience to the world's credit.

The production problem, however, is radically different. Instead of one unit produced in 10,000 man hours, we now have 10,000 brass units produced in one machine-hour. Manufacturers under the necessity of lowering production costs are finding it cheaper to buy brass parts in bulk or already assembled from a factory that specializes in producing brass items, from ingot to finished product, in large volume at low cost.

A limited number of manufacturers seeking such a source of supply are invited to avail themselves of our 60 years manufacturing experience, particularly when cupped and drawn brass parts are the problem.

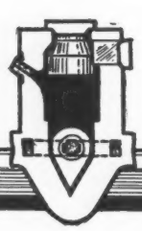
"Bridgeport" BRASS TRADE MARK CO.

Brass Products

WE MAKE

Ledrite Brass Rod
Phono-Electric Contact Wire
Plumrite Brass Pipe
Phono-Hi-Strength Wire
Tubular Plumbing Goods
Condenser Tubes-Sugar Tubes
Brass, Bronze and Copper Sheets
Brass, Bronze and Copper Tubes
Auto, Bicycle and Pressure Pumps
Auto Accessories-Stampings
Engravers' Copper-Specialties
Screw Machine Products
Pressed or Drawn Products
Flush Valves and Fittings

Electric Furnace Brass



Bridgeport Brass Company

BRIDGEPORT - CONNECTICUT

NEW YORK PHILADELPHIA CLEVELAND CHICAGO DETROIT

Member Copper and Brass Research Association

AJAX

(Trade Mark Registered)

For Locomobile Production

THE production equipment found in automobile plants is a good indication of machine efficiency. It is a significant fact, therefore, that in the automobile forge shops, Ajax Upsetting Forging Machines predominate.

This Ajax Machine at the Locomobile Company of America, Inc., Bridgeport, Connecticut, is upsetting flanges on clutch sleeves in two operations at one heat at the rate of 200 pieces per hour.

The automobile manufacturer and the commercial forge shop supplying automobile forgings find the unusual power, wide range, production efficiency and dependability of Ajax Upsetting Forging Machines an asset in maintaining consistent and profitable production.

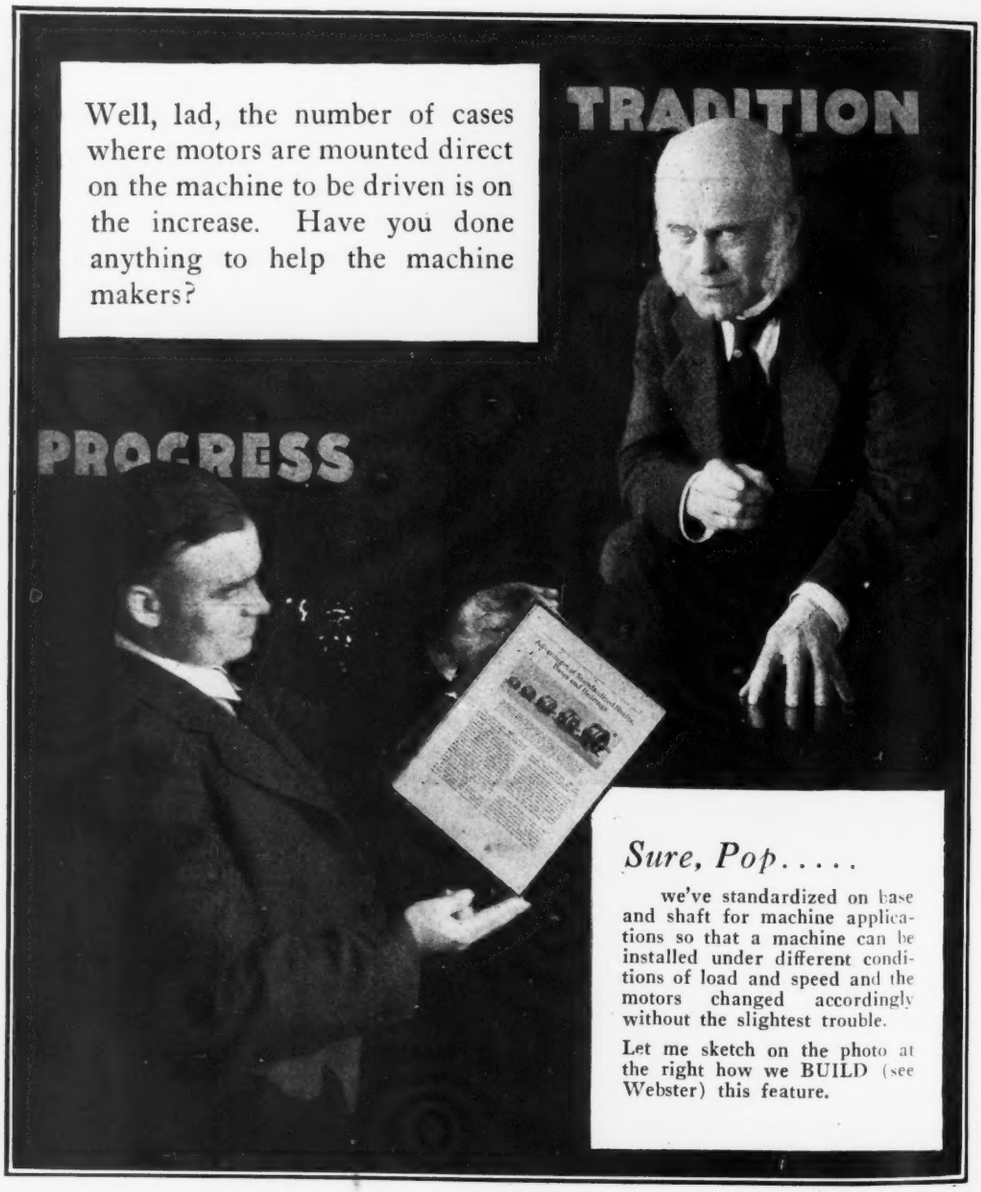
THE AJAX MANUFACTURING COMPANY, Euclid, Ohio

OFFICES: **CHICAGO, ILL., 621 Marquette Blvd.** **NEW YORK CITY, 1369 Hudson Terminal**

Let's BUILD

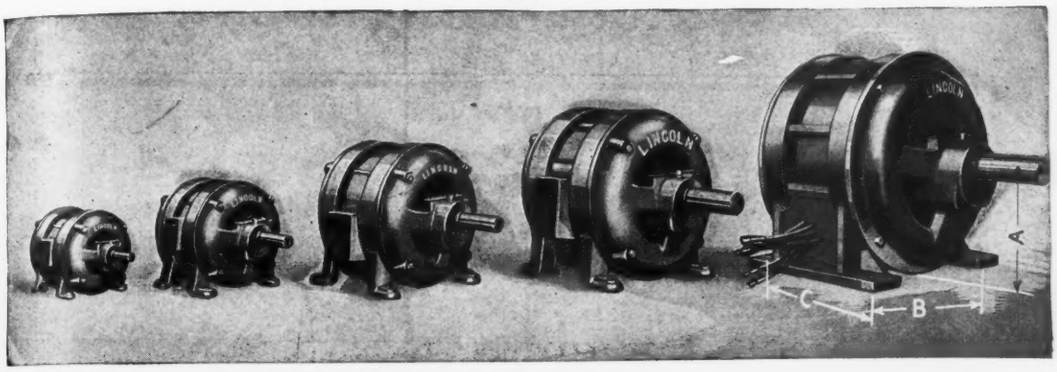
build (5)—to increase and strengthen: to increase the power and stability of: to settle or establish and preserve:
—*Webster*

What about standardization —for machine application


Well, lad, the number of cases where motors are mounted direct on the machine to be driven is on the increase. Have you done anything to help the machine makers?
TRADITION
PROGRESS
Sure, Pop.....
we've standardized on base and shaft for machine applications so that a machine can be installed under different conditions of load and speed and the motors changed accordingly without the slightest trouble.
Let me sketch on the photo at the right how we BUILD (see Webster) this feature.

LINC

a motor! with the Stable-Arc welder



Note that in our range of motors from ½ to 150 h.p. there are only five diameters of frames.

The distance "A" from the base of the motor to the center of shaft where the machinery shaft is to be coupled does not vary a hair in these different diameters—nor does the distance "B" between the bolt holes.

We get the different power capacities by increasing the distance "C."

So you see how the same standard base can be used on the machine for a large number of motor sizes.

Fans, pumps, elevators, etc., without such motor standardization would need bases for each installation because they require different sizes of motors according to load.

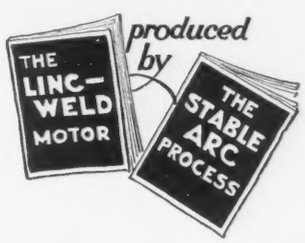
Doesn't that answer your question "What have we done for machine builders?"

And don't you think that the Stable-Arc welder, which builds this motor has also helped the machine builders to build a better product too?

The two booklets at the right tell the story in detail.

Illustrated answers

Realizing that the news value of the new process motor, as well as the process by which it is constructed, will naturally bring up many questions—two very completely illustrated volumes have been prepared thoroughly covering the subjects:



These books are in envelopes ready to be sent by return mail to all persons requesting them.

For your convenience in getting your copies—simply pencil in your address on the coupon below.

The Lincoln Electric Co.

Cleveland, Ohio

C-WELD

COUPON

To The Lincoln Electric Co., Cleveland, Ohio

Please send to Mr. .....

Company .....

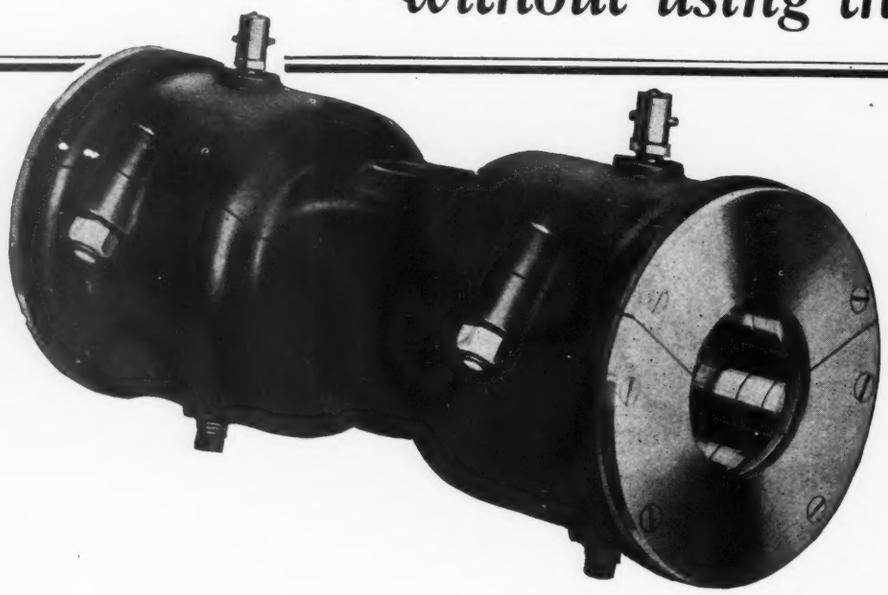
Address .....

.....

The Motor Book ☐
The Stable-Arc Process Book ☐

7-8-1

Why pay for HYATTS —without using them?



Every bit of power wasted by the steady drag of plain bearing friction grinds away a certain portion of your profits.

One year of this friction tax is usually sufficient to buy you a complete Hyatt installation—and permanent freedom from bearing troubles.

For Hyatts are practically frictionless, and wear-proof. They are rugged, durable and resilient. They need little attention—only three or four lubrications a year.

Manufacturers of various products report that Hyatt Roller Bearings are cutting their power bills 10% to 25%—an average reduction of about 15%.

Figuring the savings at $50 per horsepower per year, their investment brings an annual return of 50% to 125%. Thousands of Hyatt Line Shaft Bearings have been bringing this return for 20 and even 30 years.

And most of these original Hyatt Bearings are still rolling out dividends.

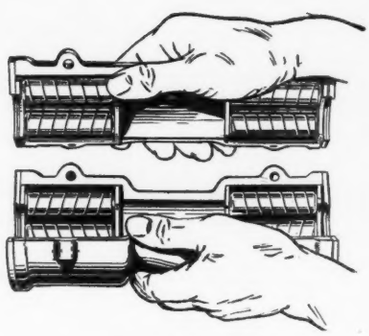
Hyatt Line Shaft Bearings, and their boxes, are split for easy installation. They can be installed in a few minutes without stripping the shaft.

Why not profit by Hyatt efficiency now?

HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO
WORCESTER PHILADELPHIA CHARLOTTE
PITTSBURGH CLEVELAND

HYATT
ROLLER BEARINGS



Completely Split for Easy Installation

These companies have used Hyatt Line Shaft Roller Bearings, in quantities of 200 to 30,000, for twenty years and more:

Colburn Mach. Tool Co.	Franklin, Pa.	20 years
Ford Motor Car Co., Detroit		20 years
Harley-Davidson Mf'g Co	Milwaukee	20 years
United Shoe Mach. Co.	Beverly, Mass.	20 years
Wallace Barnes Co.	Bristol, Conn.	20 years
Whitin Machine Co.	New London, Conn.	24 years
Davis Sewing Machine Co.	Dayton, Ohio	25 years
Roanoke Mills	Roanoke Rapids, N. C.	30 years
Greenfield Tap & Die Corp.	Greenfield, Mass.	33 years

Nearly two million Hyatt Line Shaft Roller Bearings are now in use

The OLIVER Cuts Two-Thirds off Filing Time

The Schoeder & Lombard Stamp & Die Company, New York City, makers of patterns for engraving machines and a general line of dies, installed this Oliver Die Filing Machine two years ago and have been producing their work in one-third of the time formerly required by hand filing methods. The machine is in service most of the time on an average of 48 hours per week on lapping, sawing and filing operations on brass, tool steel, zinc and a variety of other metals.

When this photograph was taken the operator was sawing out and filing from a plate of tool steel 4-15/16″ by 8″ by 3/32″ thick, a pattern of the letter F, 6½″ high and 3½″ wide for an engraving machine, at the rate of one an hour.

The Oliver Die Filing machine combines in one tool a Sawing, Filing and Lapping Machine which will finish either straight or irregular surfaces.

Send for further details.

AN OLIVER OF ADRIAN PRODUCT

THE OLIVER INSTRUMENT CO.

1410 E. Maumee Street

Adrian, Mich., U. S. A.

Get the Tap to Suit the Job

That's the first requisite to efficient tapping; the second is to be sure of the quality of the tap.

"HANSON" H PROCESS

Hanson Process Taps—finished after hardening—are uniform in quality, lead, pitch, relief and diameter.

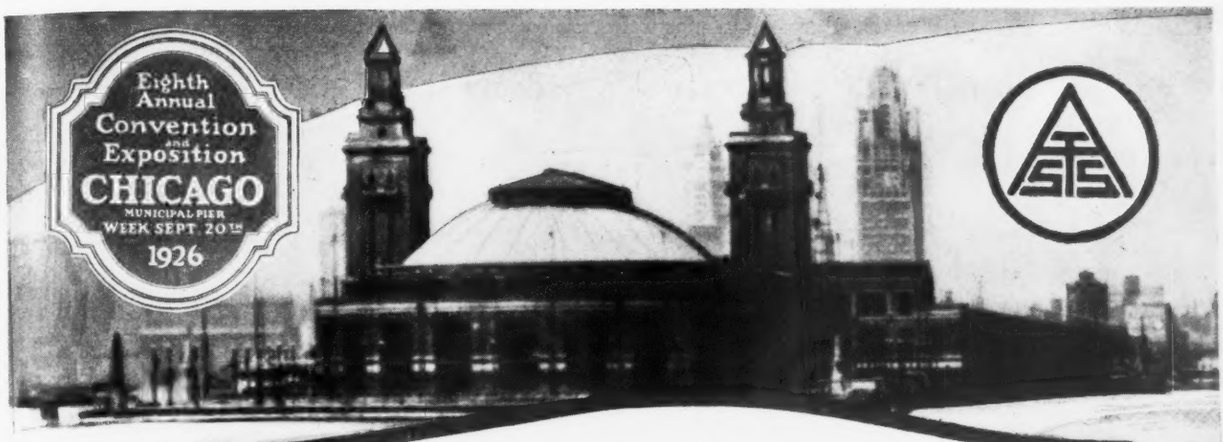
There are Hanson Process Taps for every type of tapping operation—Hanson Tap designers are ready to produce tools to meet new tapping needs or to fit your special requirements.

Send for Catalog and price list of Hanson-Whitney Taps.

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
BOOTH NO. 373

The Hanson-Whitney Machine Co.

Hartford, Conn.



The Eighth Annual National Steel and Machine Tool Exposition of the American Society for Steel Treating will be the largest ever held. It is known as a truly remarkable sales market, bringing together buyers and sellers under the most favorable auspices.

Exhibitors include over 300 of the most progressive companies in the steel and machine tool industry. The owners, engineers, the executives of manufacturing plants from every part of the country will be in attendance. The men whose work requires them to keep ahead of the times come to see—to ask—to buy. The men who are experts in each industry are here to show—to explain—to advise. The Exhibition itself, 80,000 square feet, will be the largest industrial show ever held in Chicago.

And there will be plant inspections showing how the other fellow is doing it—and, coincidentally you will be able to take in the technical program of the A.S.S.T. and Production Meeting of the S.A.E. and the sessions of the Machine Shop Practice Division of the A.S.M.E.

American Society for Steel Treating

Ask your banker!

Give him the necessary figures and ask him if you should invest your money in new machine tools.

Cold-bloodedly he will take his pencil and answer you from the "never gamble" viewpoint. If he shows you that you could make money by replacing obsolete tools with modern equipment—then do it.

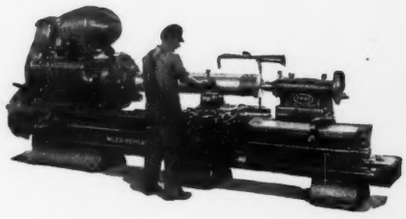
For the greatest asset a new tool has is entirely discounted by a banker. He only figures what the tool will put into your pocket. It does not concern him that it will put into the minds of the operators a satisfaction that produces good work and as much of it as the machine will do.

The banker figures cash and profits that can be counted and seen. Yet new equipment has an intangible effect on a whole organization and often steps up the production.

Sometimes one new tool in a key position in a shop will increase production on all machines, especially if your present machine is a "neck-of-the-bottle."

It can do no harm to get the production figures on your present machine tools and to let us give you the production you could expect from new tools. The rest of the story your cost men can give you very quickly.

Send us a list of your tool equipment with the year of purchase and the type and quantity of work you are now doing annually.



TIME SAVER LATHE

Write for a catalog describing this—
"the most modern lathe"

What we make

TIME SAVER PLANERS

TIME SAVER LATHES

RIGHT LINE RADIAL DRILLS

VERTICAL BORING MILLS

HORIZONTAL BORING MILLS

SIDE HEAD BORING MILLS

BEMENT STEAM HAMMERS

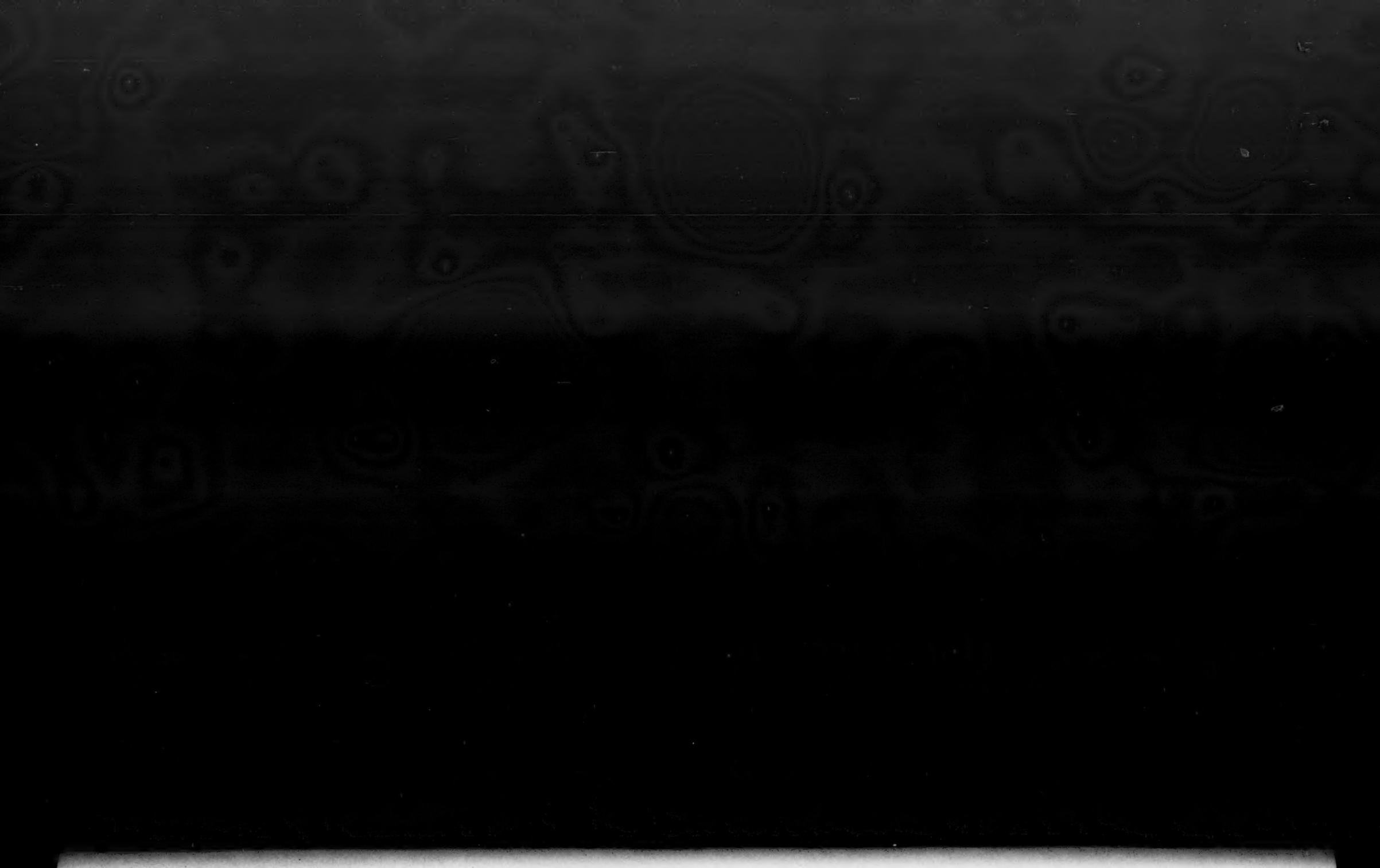
SLOTTERS

Complete line of
Special Railroad Machines,
Plate Working Machinery, etc.

The Niles Tool Works Company

Division Niles-Bement-Pond Company

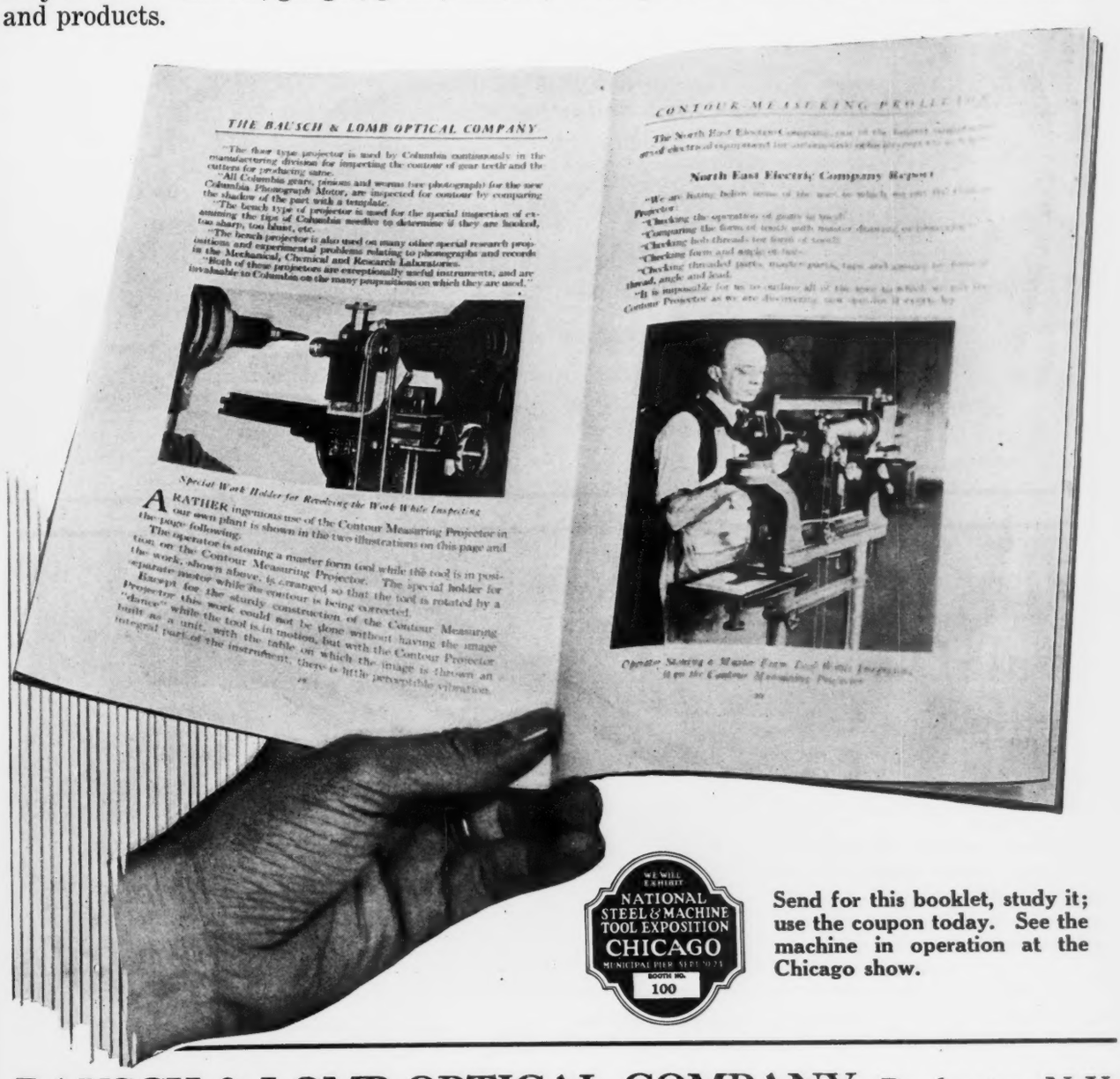
Hamilton, Ohio



OPEN THE BOOK—

Every page tells a story of Contour Measuring Projector Service in some well known plant; of the simple, practical solution of some measuring problem in which scientific accuracy is required.

Machine tool builders, automobile and industrial manufacturers tell here how they use B & L Contour Measuring Projectors in laboratory and shop to check and insure the accuracy of screw threads, gauges, gears, chasers, cutting tools of all kinds, of important parts and products.


THE BAUSCH & LOMB OPTICAL COMPANY
Special Work Holder for Rotating the Work While Inspecting
North East Electric Company Report

Operator Showing a Master Form Tool While Inspecting It on the Contour Measuring Projector

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT. 20-25
BOOTH NO. 100

Send for this booklet, study it; use the coupon today. See the machine in operation at the Chicago show.

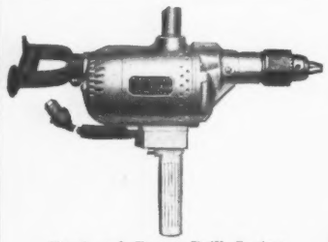
BAUSCH & LOMB OPTICAL COMPANY, Rochester, N. Y.

BAUSCH & LOMB OPTICAL CO., 662 St. Paul St., Rochester, N. Y.

Gentlemen:—Please send me a copy of your Booklet as advertised in MACHINERY.

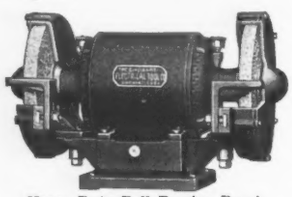
Name ..... Firm .....

Address ..... Position .....



Hand and Breast Drill 5 sizes —¼" to ⅝" Weights, 5 to 22 pounds. Single and two speeds. Ball bearing, air cooled.

Screw Feed Drill, 4 sizes— ⅞" to 2½". Single and two speeds.



Heavy Duty Ball Bearing Bench and Floor type Grinders. 6 sizes—¼ to 5 H.P. Fully enclosed safety wheel guards.

Particular Tools for Particular People. Try 'em Out. Return if Not Satisfactory

The Cincinnati
Electric Drills·Grinders·Buffers

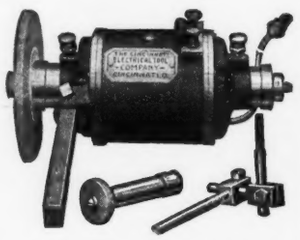
"Cincinnati" Electrics are guaranteed Mechanically and Electrically. They stay on the job and are especially built for hard usage. It is not what we say but what our tools do that bring in the duplicate orders.

CATALOG?

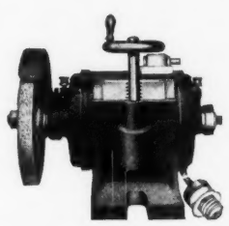
The Cincinnati Electrical Tool Co.
LeBlond Bldg., Cincinnati, Ohio

BRANCH OFFICES:

New York	50 Church St.
Philadelphia	1220 Real Estate Trust Bldg.
Cleveland	564 Erie Bldg.
Chicago	J. G. McLean, 564 W. Randolph St.
New Orleans	Oliver H. Van Horn Co., Inc.
San Francisco	W. H. Gilbert, Jr., 1710 Larkin St.
St. Louis	St. Louis Machinists Supply Co.
Birmingham	The Young & Vann Supply Co.



Tool Post Grinder, with and without feed. 7 sizes, ¼ to 3 H.P. Various types. For light and heavy work.



Parallel Grinder—Vertical Feed for grinding Spindles, Rolls, Journals, Bushings and parallel work of all kinds. 4 sizes, ½ to 3 H.P.

Hand and Suspended Grinder. 5 sizes, ¼ to 3 H.P. For cleaning castings, buffing or polishing.

COGSDRILL
Small Diameter Drills

by the makers of the famous

Cogsdrill Center Drills

The same highly developed methods of forming and hardening that have made our Cogsdrill Center Drills standard tools in many shops, are used in the manufacture of our new line of Cogsdrill Small Diameter Drills.

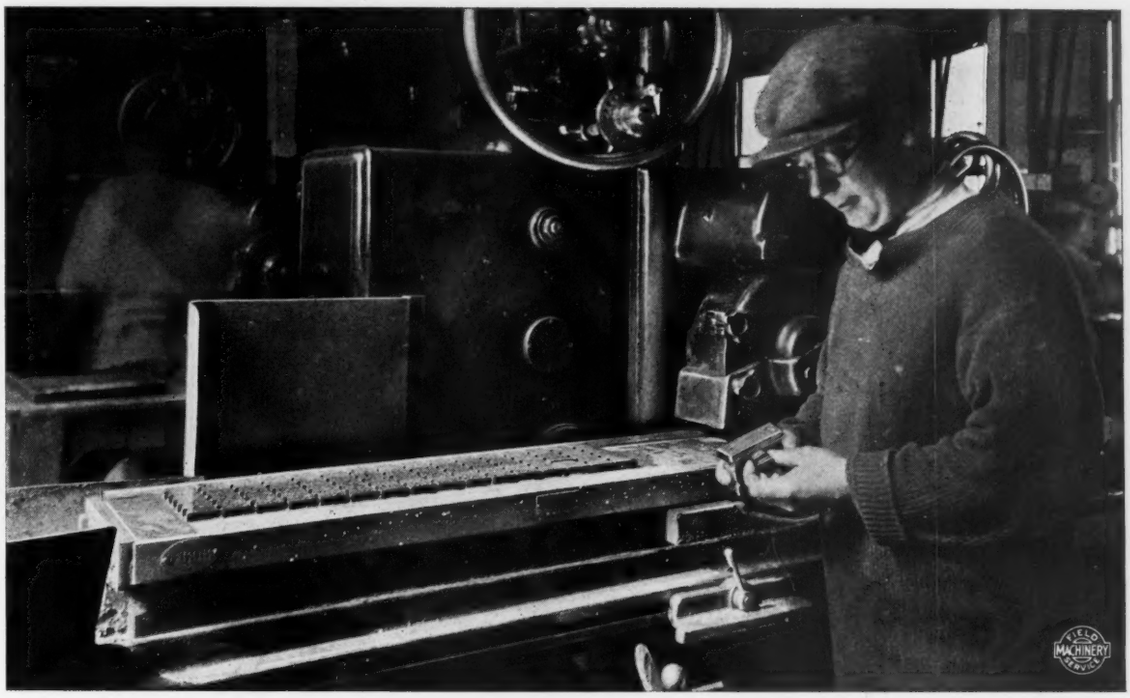
Though Cogsdrill Small Diameter Drills have only been on the market for a very short while, they, too, have already become production standbys in many shops on a wide variety of work.

They last long and maintain their accuracy throughout their life.

Let us send you a few Center Drills or Small Diameter Drills on trial. All sizes in stock, including numbered, lettered and fractional sizes.

COGSDILL MFG. COMPANY, DETROIT, MICH.

WORCESTER INDUSTRIES



Walker Magnetic Chucks

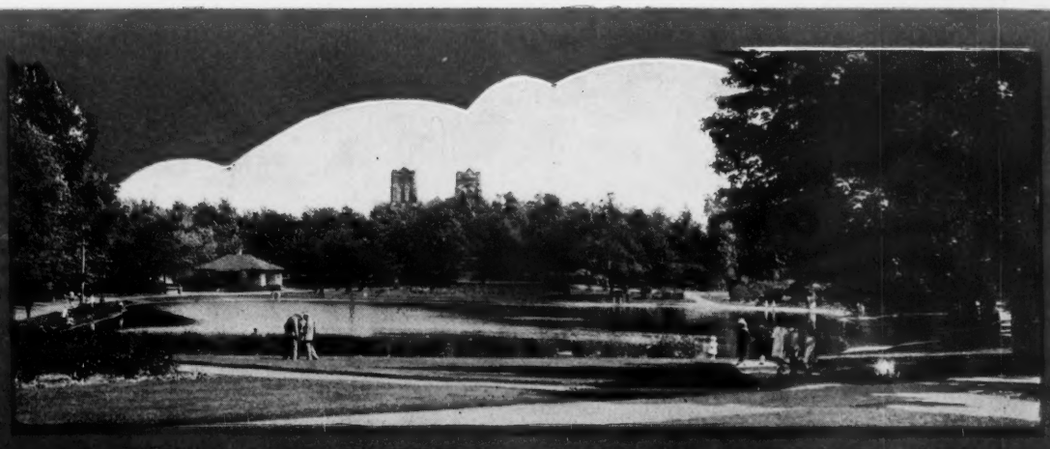
For Efficient Production on Geometric Die Heads

Ninety-six chasers for new model Geometric Style K Die Heads set up on a Walker Magnetic Chuck for finish grinding.

This glimpse of modern production methods illustrates the *necessity* for Walker Chucking Equipment in the modern plant. The modern manufacturer uses Walker Magnetic Chucks to hold small irregular parts for finishing in quantity; he finds them indispensable for chucking large irregular shaped single pieces without the aid of expensive jigs and fixtures.

"The best way to hold most work, the only way to hold some of it"—we can show you Walker Magnetic Chucks in service on practically all classes of large and small work.

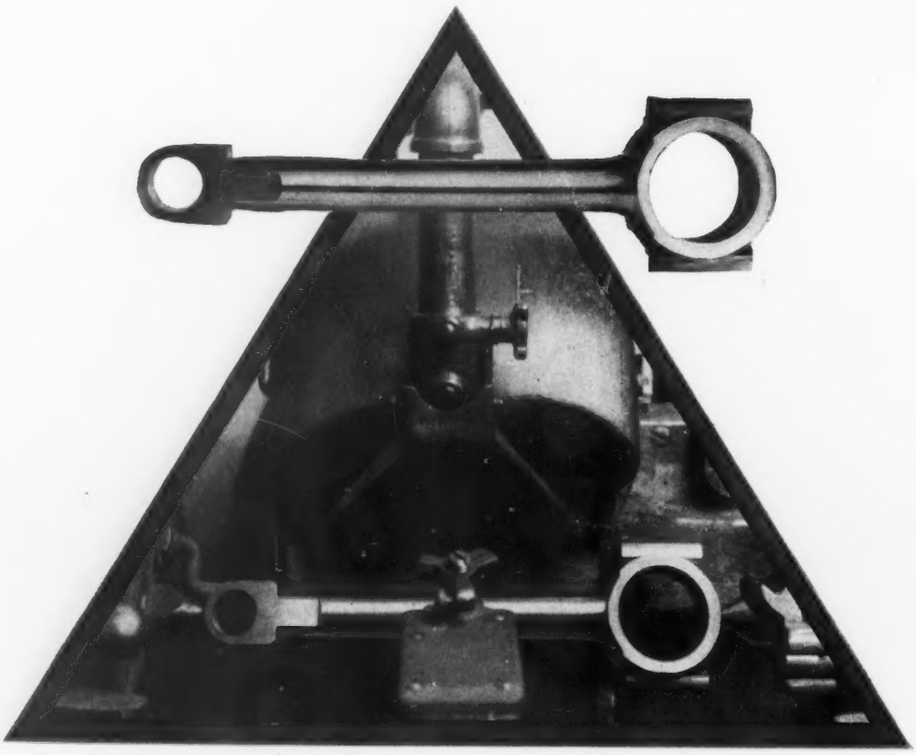
O. S. WALKER CO., Inc., Worcester, Mass.



A city's recreation centers are as important as its industrial activities—a bit of University Park in Worcester.

WORCESTER INDUSTRIES

Increasing



By WIDE WHEEL GRINDING

This job is an excellent example of the efficiency of the wide wheel method of grinding. The part is a forged steel connecting rod with a large radius on one end and a small fillet on the other. It is ground in one operation on a Norton machine with a 9-11/16" wide, formed wheel and in a fraction of the time that would be required for the form cuts and traversing otherwise necessary.

From .025 to .030" of stock is removed from this 1¼" diameter to a limit of .002". The wheel is a Norton 20x9-11/16x12" 1946K Alundum.

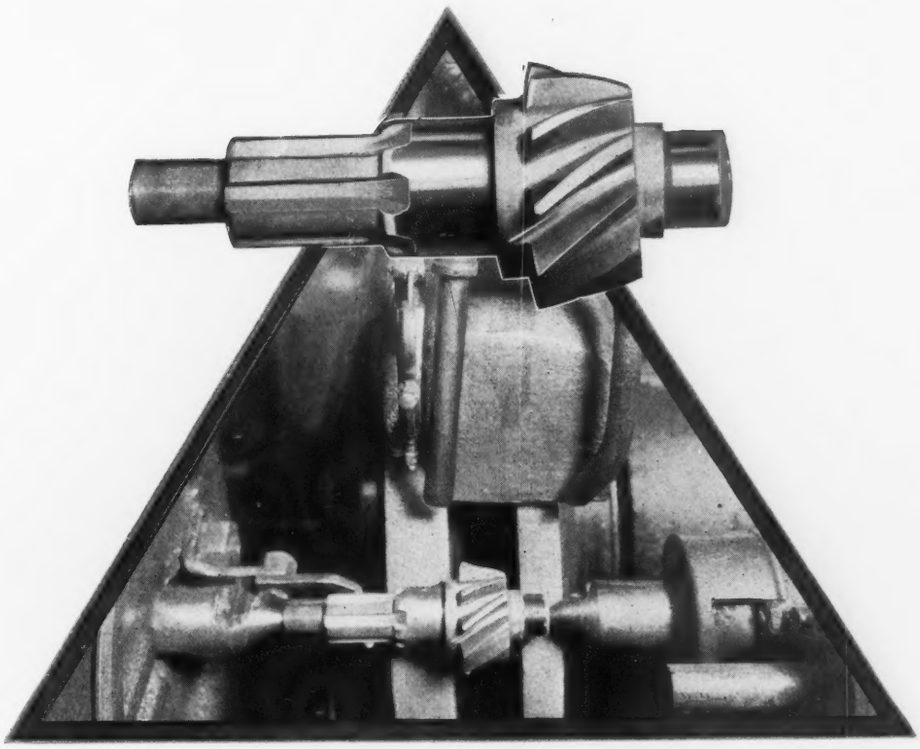
NORTON COMPANY
WORCESTER, MASS., U.S.A.

M-153

South Worcester Playgrounds—the beginning of some of our greatest champions may be here.

WORCESTER INDUSTRIES

Production



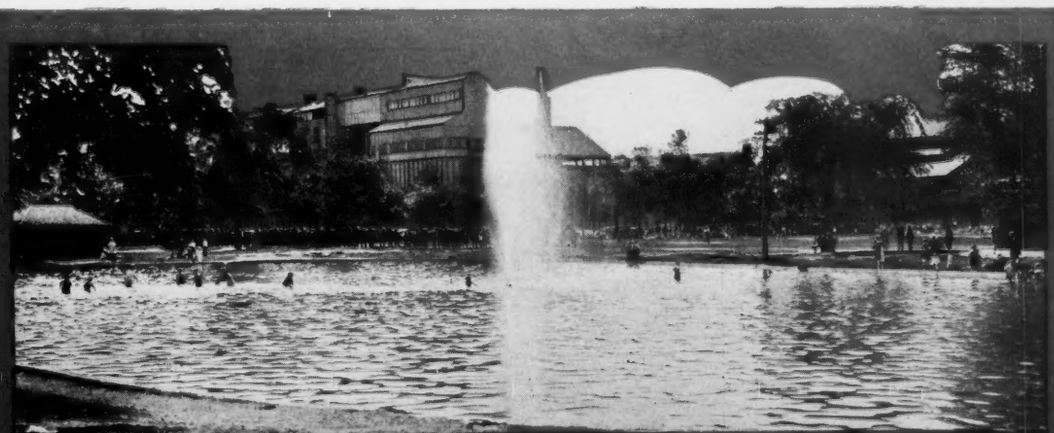
By TWIN WHEEL GRINDING

Here is another job where the Norton Twin Wheel method has made a big saving in production costs. The two bearings—formerly ground one at a time as separate operations—are now done in one operation in the same time previously required for grinding only one of them.

The part is a steel drive pinion 6½" long by 0.984 to 1.377" diameter and both bearings are held to 0.0005" limit. The wheels are Norton vitrified 24CM Alundum.

NORTON
GRINDING MACHINES

M-153 M-150

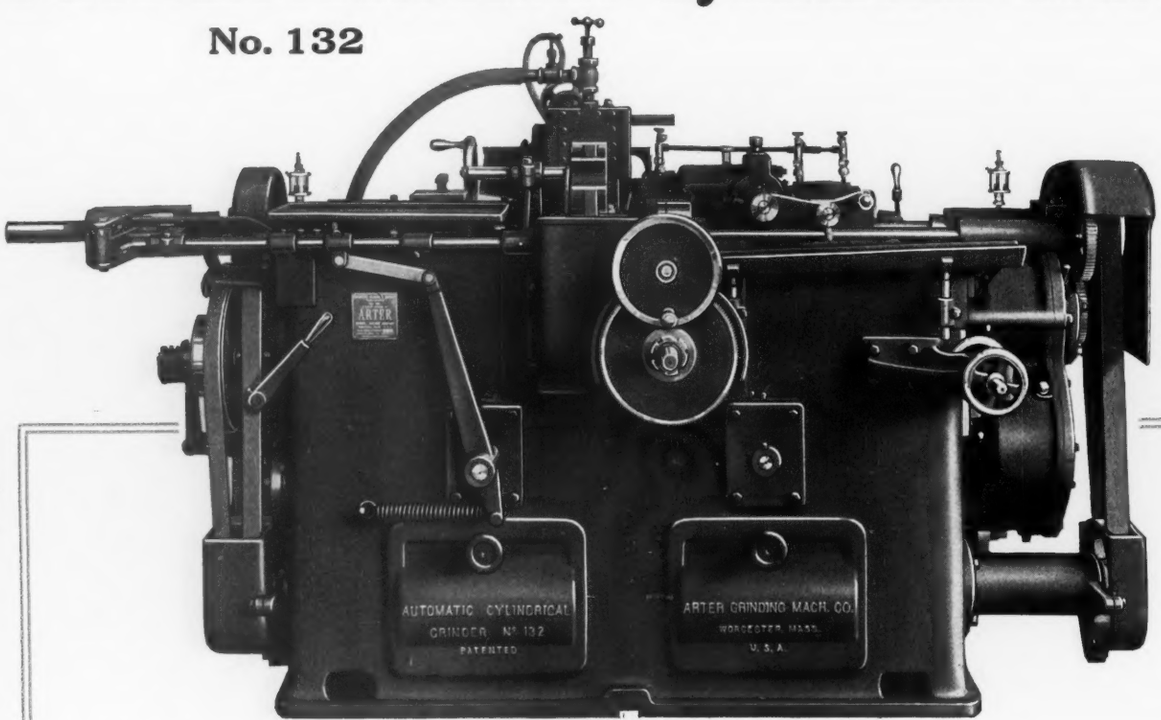


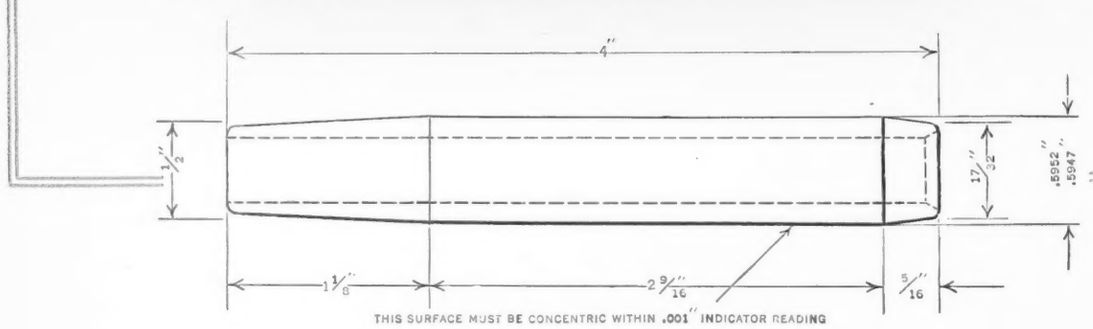
Crompton Park —cool water, green grass and a ball game for excitement.

WORCESTER INDUSTRIES

ARTER Automatic Cylindrical Grinder

No. 132





Concentric Accuracy

Valve stem guides—8 pieces per minute handled automatically, on centers, without arbors and the outside diameter ground concentric with the bore within .0005".

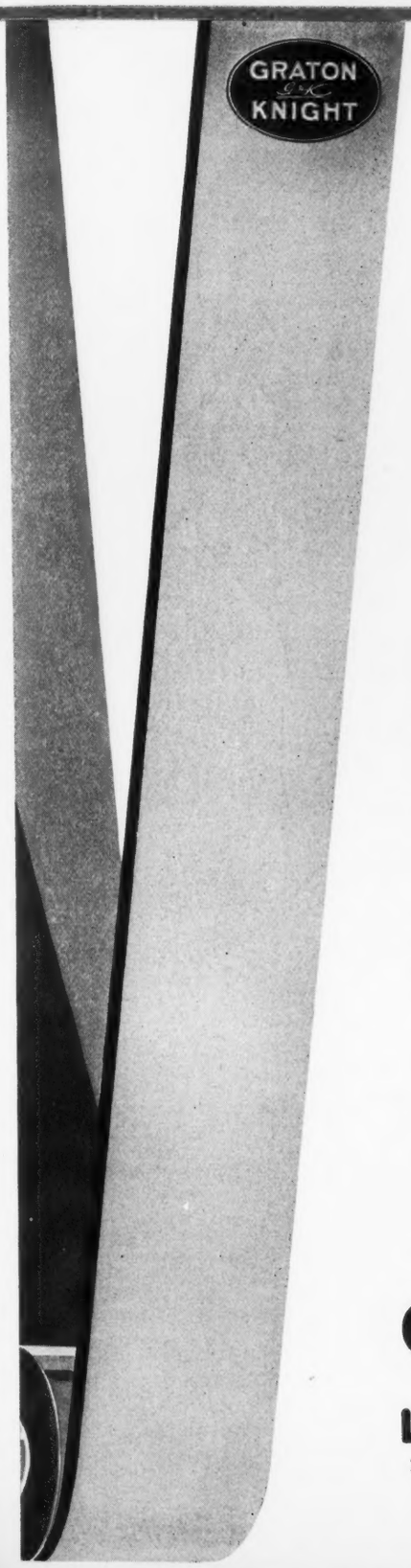
This is but one of the many jobs handled where concentricity of one diameter with another is required.

THE ARTER GRINDING MACHINE COMPANY

72 Commercial Street, WORCESTER, MASS.

The band stand in Elm Park—the rustle of trees, the ripple of water, and music—what more is needed?

WORCESTER INDUSTRIES



4¢ more here *means* longer life here

EVERY business man will recognize this fact; that the character of a finished product depends largely on the character of the raw materials used. The manufacture of Graton & Knight leather belting is based on that principle.

Eleven grades of hides are offered to belting manufacturers. Only two of these are equal to the exacting specifications laid down by Graton & Knight. Their cost per pound averages from 33-1/3% to 45% higher. But they are the most uniform, the most skillfully removed, the strongest fibred hides that can be bought.

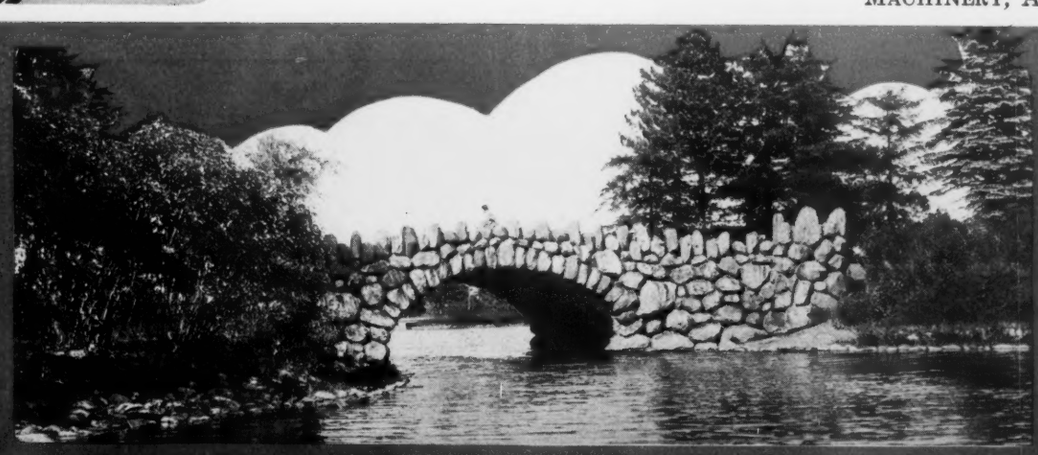
They make the best belting leather; belting leather that has the capacity for long life. And that's what you, the user of power belting, are most vitally interested in when you belt the drives in your plant.

Graton & Knight leather belting is the product of a controlled process, every step of which, from the purchase of the hide to the selection of the right belt for the right drive, is governed by chemical and engineering exactness. That's why Graton & Knight belts last longer.

GRATON & KNIGHT COMPANY
WORCESTER, MASSACHUSETTS
Branch Offices Throughout the World

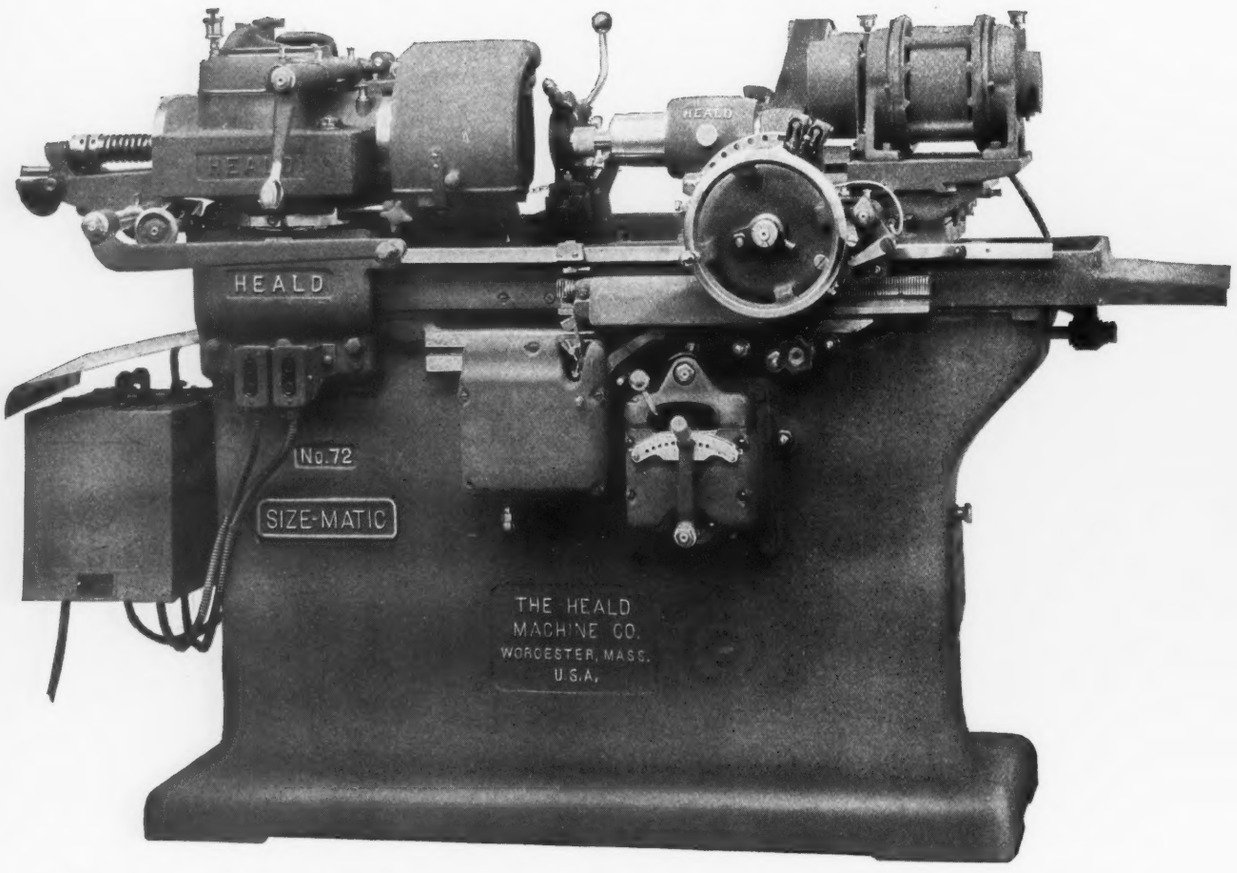
GRATON & KNIGHT
Standardized
LEATHER BELTING LASTS LONGER

The "STANDARDIZED BELTING MANUAL" contains 170 pages of useful information about belting, how to use it, take care of it, and make it deliver the most for your money. Send for a copy. Address Dept. 101-Y



The stone bridge —at Burncoat Park—another Worcester breathing place.

The Heald SIZE-MATIC Arranged for Motor Drive



The above illustration shows the Heald SIZE-MATIC arranged for motor drive. This consists of two motors: one, mounted on the back of the machine, drives the main shaft operating the table-traverse and workhead; the other, mounted on the cross-slide, furnishes power to the grinding spindle.

These motors, built into and practically a part of the machine itself, are furnished as regular equipment. The one on the cross-slide for the wheelhead drive is 5 H.P., giving ample power. It is equipped with special ball bearing end shells designed and built by us to give the very best protection for the bearings from dust and abrasives, yet allowing ample ventilation. Suitable starting equipment is also furnished with each machine.

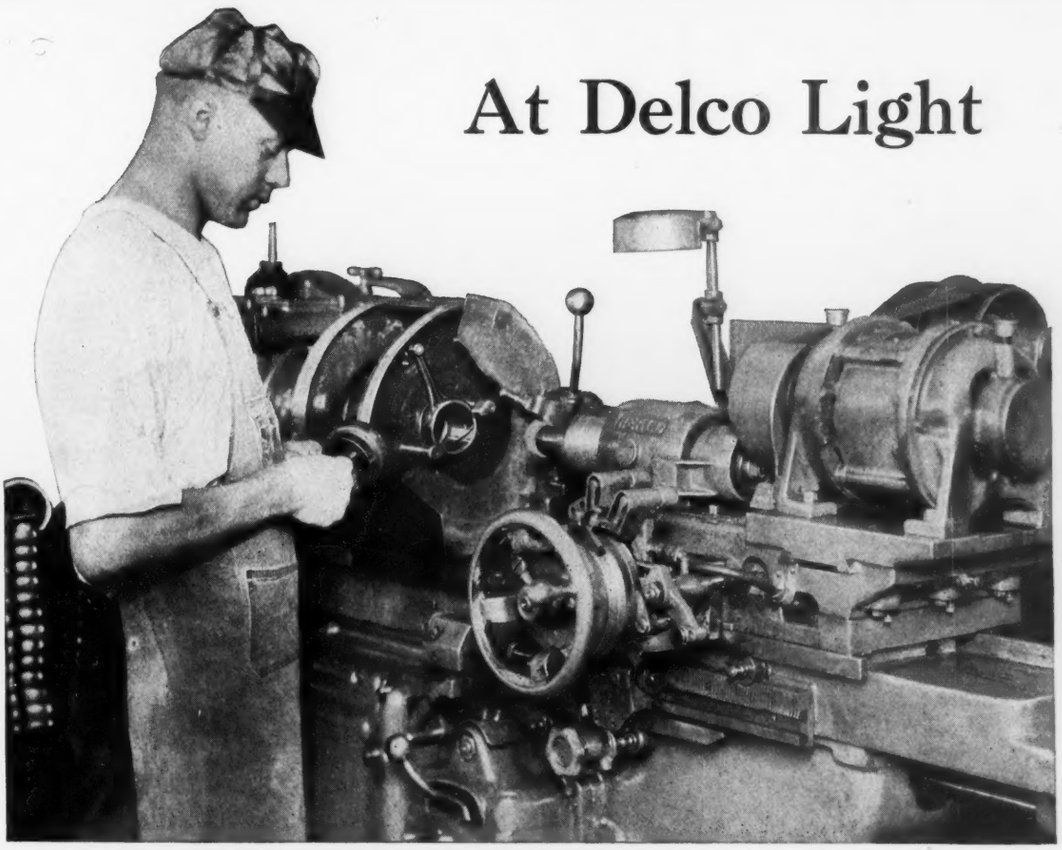
THE HEALD MACHINE COMPANY 16

Has held the trade's confidence for 100

Sunshine and shadow in Elm Park—ideal for a stroll, a chat or a restful hour.

WORCESTER INDUSTRIES

At Delco Light



The photo shows the operator checking connecting rods which have just been ground on the Heald SIZE-MATIC at the Delco Light Company, Dayton, Ohio, manufacturers of the Frigidaire Household Refrigerator.

Piece after Piece well within the Limits

The Heald SIZE-MATIC plays a very important part in turning out hundreds of Frigidaire Refrigerators daily, at the Delco Light Company, Dayton, Ohio.

Not only is it used for grinding the cylinders of this equipment but also connecting rods as illustrated above.

Even though the material is very hard and the hole has deep oil grooves, the SIZE-MATIC automatically sizes without trouble, giving the finish required, which must be extra fine. Production is trebled and the scrap has been reduced to less than 1%.

You will never know how obsolete your Internal Grinders are until you get our SIZE-MATIC figures. A print or samples with data will bring you complete information.

Equipment, not man power, is the dividend producer of today.

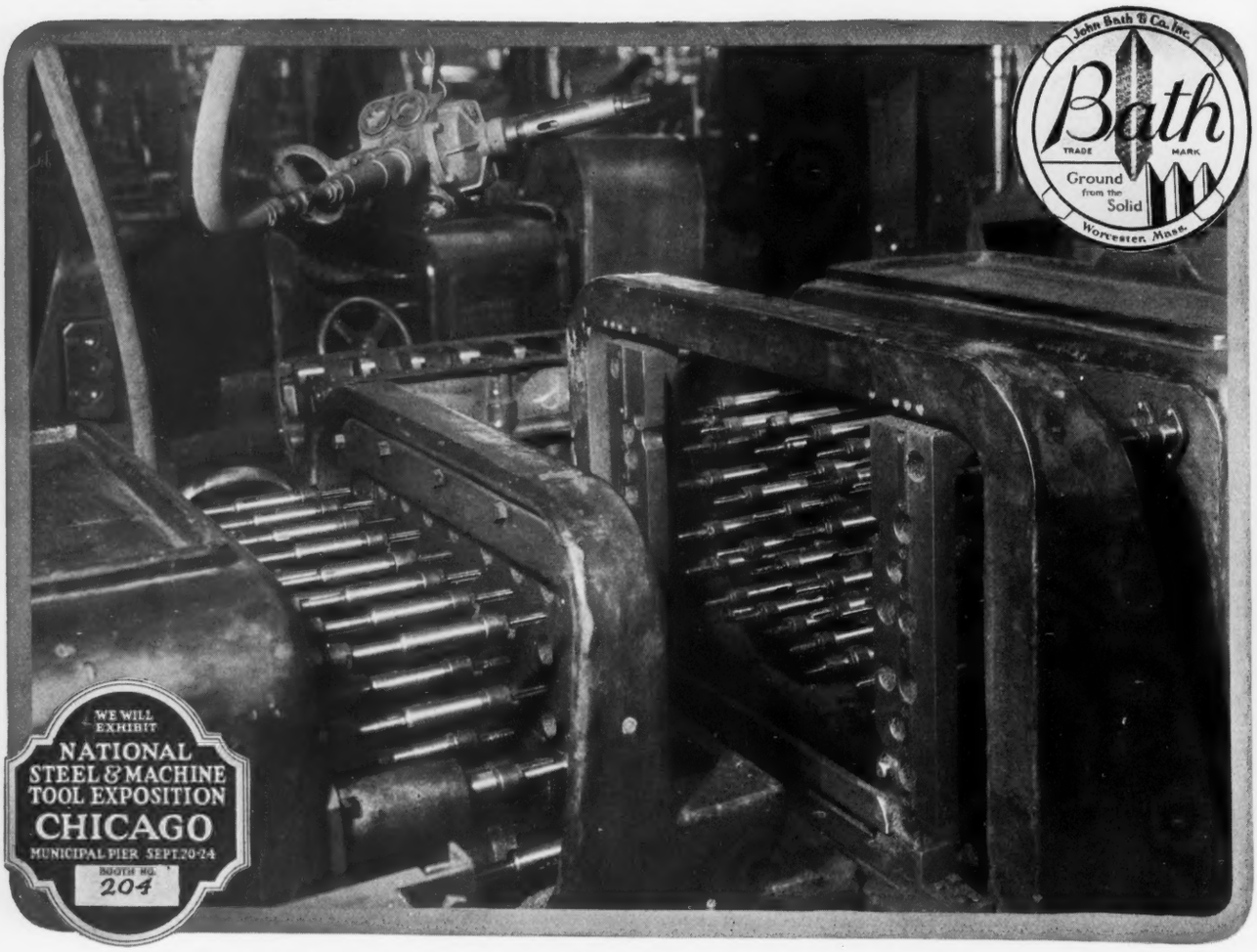
NY 16 New Bond St., WORCESTER, MASS.

for 100 years. Established in 1826

Green Hill Park —safe for the small folks and a joy to their elders.

WORCESTER INDUSTRIES

Tapping Costs Reduced 60%!



Sixty BATH High Speed Ground Taps in a Multiple Set-up for Tapping the holes on an Automobile Engine Block.

One Automobile Manufacturer says BATH Ground Taps have reduced his Tapping Costs 60% in the past year. He buys taps on a "TOOL COST PER MOTOR" basis.

CAN YOU AFFORD to put off that trial of BATH GROUND TAPS?

JOHN BATH & COMPANY, Inc.

WORCESTER, MASS.

Pittsburgh	**Philadelphia**	**Los Angeles**
Detroit	**Cleveland**	**New York**
Chicago	**San Francisco**	**Cincinnati**

Bancroft Hill, overlooking the town; the American Steel & Wire Works in the distance.

Why the Chain Drive

The great flexibility of the chain,

Its compactness as a drive,

Its dependability and application where unfavorable conditions render the use of other drives impractical or impossible,

Together with the fact that its efficiency does not materially decrease with long and hard usage,

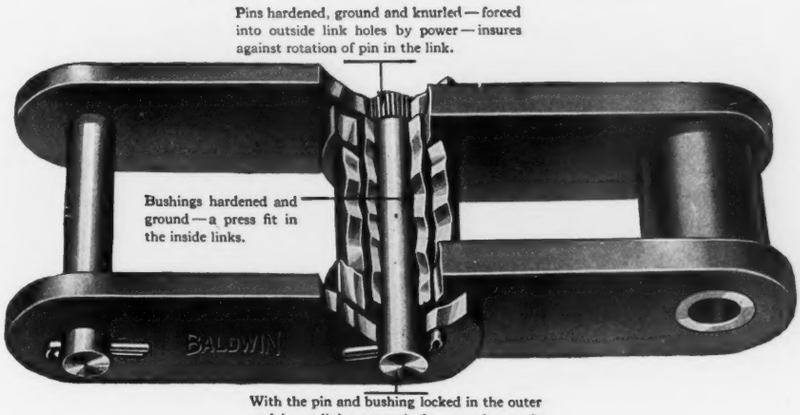
All contribute to the steady increase in the use of chain drives in every industry.

Why BALDWIN Chain Drives

First—**For thirty years** Baldwin has built one product—machine finished Steel Roller Chains and Sprockets—our motto always to build "up to a standard" rather than "down to a price".

Second—**Baldwin Construction**—Study the design as graphically shown.

STEEL REPLACEMENT SERIES


Pins hardened, ground and knurled—forced into outside link holes by power—insures against rotation of pin in the link.
Bushings hardened and ground—a press fit in the inside links.
BALDWIN
With the pin and bushing locked in the outer and inner links respectively, wear is evenly distributed over the entire length of pin and bushing.

Made in cotter pin (detachable) or riveted type

In the Worcester Section we have in the last six issues illustrated Baldwin operating successfully in the following industries:—

BRICK MANUFACTURE	**PAPER MILL**
CONTRACTORS' EQUIPMENT	**TANNERIES**
LUMBER MILL	**TEXTILE PLANT**

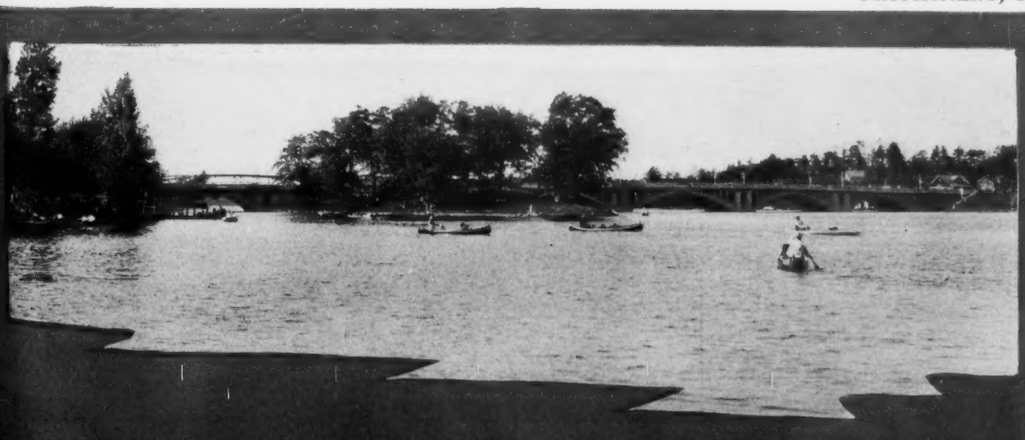
You too—whatever your transmission or conveying problems, will

WIN with BALD-WIN

Ask for Bulletin No. 13 Standard Roller Chain
Bulletin No. 27 Steel Replacement Chain
Bulletin No. 29 Precision Silent Chain

BALDWIN CHAIN & MFG. COMPANY

WORCESTER, MASS., U. S. A.

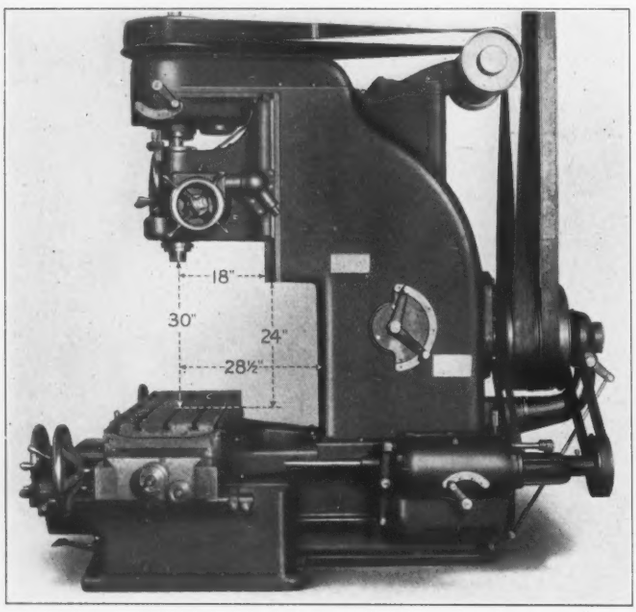


Lake Quinsigamond Bridge, showing Lincoln Park at the left

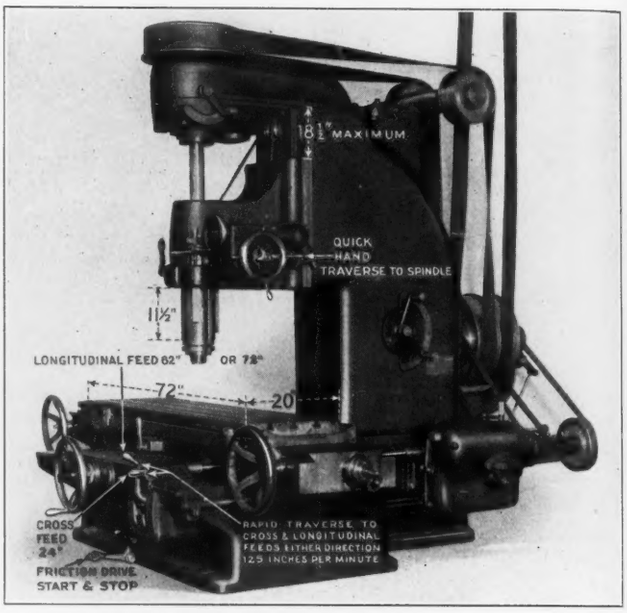
WORCESTER INDUSTRIES

New Model No. 6 Becker Die Sinker and Vertical Milling Machine

Permits ready machining of the largest and heaviest die blocks and castings



Spindle and head at extreme height showing maximum distance spindle to table, center of spindle to column, etc.


18½" MAXIMUM
QUICK HAND TRAVERSE TO SPINDLE
11½"
LONGITUDINAL FEED 62" OR 72"
72"
20"
CROSS FEED 24"
RAPID TRAVERSE TO CROSS & LONGITUDINAL FEEDS EITHER DIRECTION 125 INCHES PER MINUTE
FRICTION DRIVE START & STOP

Spindle and head at lowest point, showing adjustment of spindle and head, etc.

FEATURES of the previous Becker Die Sinkers and Vertical Millers have been maintained in this new model including belt drive to spindle permitting proper speeds for end mills and die sinkers' cutters. While maximum speed is 500 R.P.M., in some cases speeds of 1000 and 1200 R.P.M. have been used satisfactorily with this construction. 5" Spindle drive belt insures sufficient power to the cutter.

New features include triple gearing in head, spindle with either clutch type or threaded nose; speed and feed change mechanisms; power down feed to head for vertical milling; adjustable head and spindle quill; rapid traverse to longitudinal and cross feeds in either direction. All feed gears of alloy steel, running in oil.

Rotary table hand or power feed, 26" diameter, can be supplied if desired.

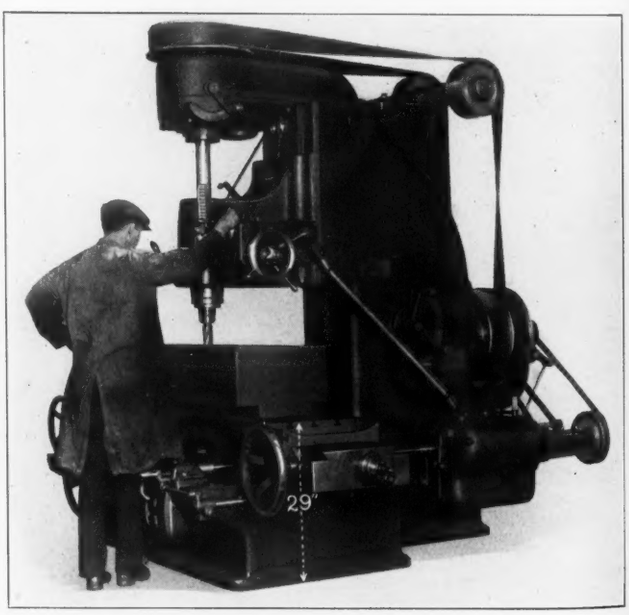
MACHINE TOOLS

REED-PRENTICE CORP.

WORCESTER MASS., U.S.A.

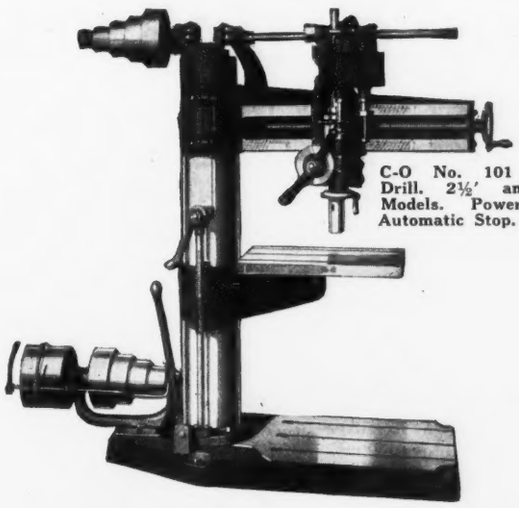
Representatives throughout the World

Branch Office: 3-245 General Motors Bldg., Detroit, Mich.
Branch Office: 1810 Singer Bldg., New York City.

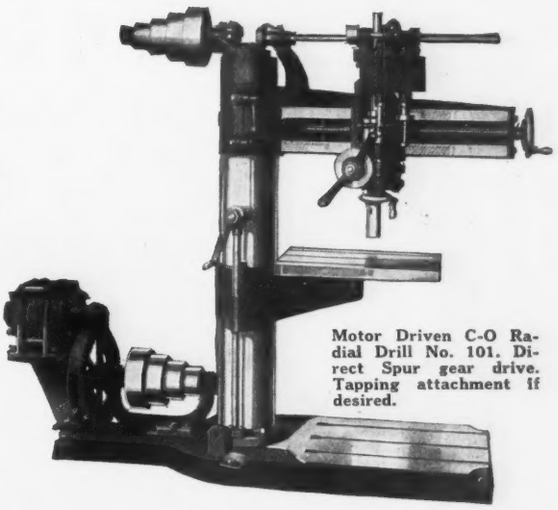


Becker No. 6 in operation.

The Tennis Court and Gardens at Bancroft Park—all the joys of a summer day are here.

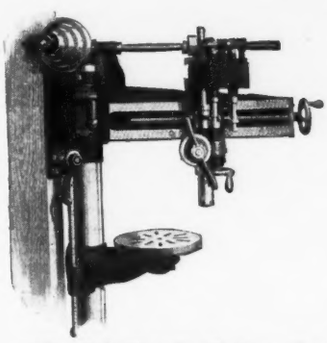


C-O No. 101 Radial Drill. 2½′ and 3½′ Models. Power Feed Automatic Stop.

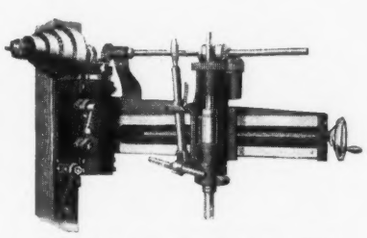


Motor Driven C-O Radial Drill No. 101. Direct Spur gear drive. Tapping attachment if desired.

C-O Radial Drills Cost Less— Earn More—Than Others



The C-O No. 51 Wall or Post Radial Drill effects a material saving. Power feed, Automatic stop, Four speeds, easily changed by sliding collar. Self-oiling countershaft. Furnished with 2½′ or 3½′ arm.



The C-O No. 50 Bob-tail Wall Type Radial Drill offers the operating features of high priced drills at absolutely minimum cost. Hand or Power Feed and automatic stop. Four speeds. Self-oiling shaft. 2½′ or 3½′ arm.

For economical, high quality production, Canedy-Otto Radial Drills are without equal. Their initial low cost, dependable operation and freedom from repairs make them the most profitable machines of this type ever built.

Canedy-Otto Radial Drills embody time-tried and proved principles of construction throughout, with working parts that are strong, simple, compact and accurate. In durability, lasting quality and beauty of finish, they fully satisfy the most rigid requirements.

But for the complete manufacturing facilities of the Canedy-Otto organization, embracing every step from raw pig to finished product, and the specialized skill gained in fifty years of quality machine tool building, it would be impossible to offer so fine a product at so low a price.

Start today to cut your production costs and to build for larger volume of output by sending for Bulletins, showing a complete line of drills.

Successful Manufacturers for 50 Years

CANEDY-OTTO MANUFACTURING CO.

Manufacturers of Automotive Equipment, Drills, Punches, Shears, Shrinkers, Countershafts, Grinders, Buffers, Forgers, Blowers, Tuyere Irons and Blast Gates

CHICAGO HEIGHTS, ILL.

COMPLETE STOCK CARRIED AT BRANCHES

San Francisco Branch:
955 FOLSOM STREET,
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If you'll sign and return this Inquiry Coupon we'll be glad to send to you, without obligation, illustrated data and complete information covering the equipment you may be specially interested in.

Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Gentlemen:
We are interested in:

_____

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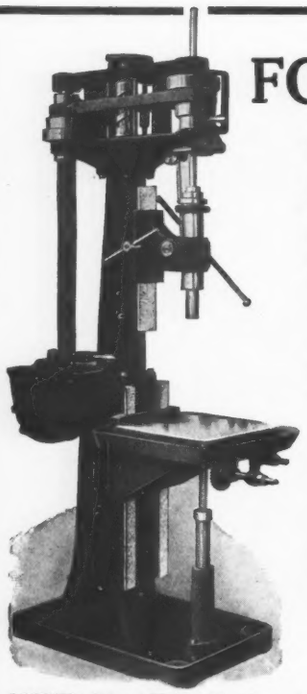
Name _____

Individual _____

Address _____

Town _____

State _____ B-1

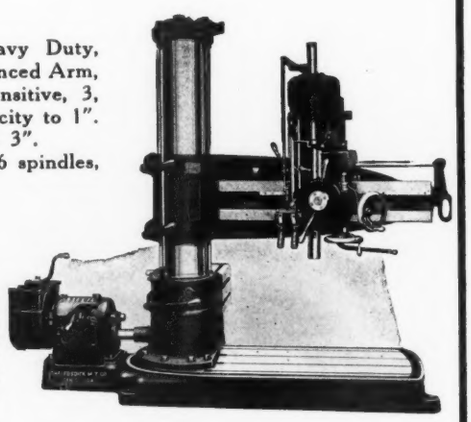


FOSDICK DRILLING MACHINES

The Fosdick Line of drilling machines includes equipment for every drilling need. For tool room, or for the stiffest production schedule, the heaviest work or the lightest, Fosdicks are thoroughly dependable. Drilling equipment you can buy with the assurance of getting a full dollar's value for every dollar expended—and prices are interestingly moderate. Let us send further details of these machines.

FOSDICK

Radials—All geared, High Speed to Heavy Duty, 2 to 6 ft., capacity 3/16" to 4" drills. Balanced Arm, motor driven, 4 to 6 ft. High Speed Sensitive, 3, 3½ and 4 ft. for drilling and tapping, capacity to 1". **Uprights**—21" to 30". Capacity 3/16" to 3". **Ball Bearing Sensitives**—13" to 24", 1 to 6 spindles, capacity to 1⅛".

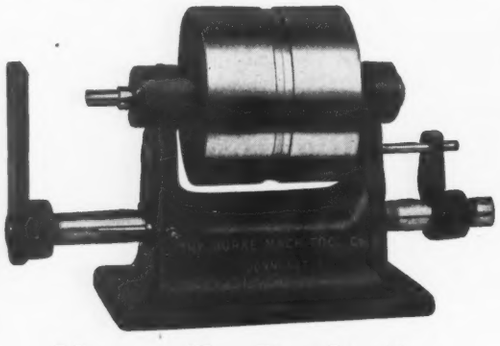


AGENTS: Colcord-Wright Machinery & Supply Co., St. Louis, Mo. Barbour, Love & Woodward, New York, N. Y. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. Peninsular Machinery Co., Detroit, Mich. Homer Strong Co., Rochester, N. Y., Buffalo, N. Y. H. A. Smith Machinery Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. Somers, Fitler & Todd Co., Pittsburgh, Pa. Stocker-Rumely-Wachs Co., Chicago, Ill., Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Machinery Co., Toronto, Ont., Canada. The Mine & Smelter Supply Co., Salt Lake City, Utah. Moore-Handley Hardware Co., Birmingham, Ala. C. F. Bulotti Mchy. Co., San Francisco, Calif. Eccles & Davies, Los Angeles, Calif. The Cleveland Tool & Supply Co., Cleveland, Ohio. Bay Verte Machinery Supply Co., Green Bay, Wis. Burton, Griffiths & Co., London, England. Fenwick Freres Co., Paris, France. Wynmalen & Hausman, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonesson & Co., Malmo, Sweden, Copenhagen, Denmark.

THE FOSDICK MACHINE TOOL CO., Cincinnati, Ohio, U.S.A.

BURKE

Tapping Machines



Unusually Productive

Lower tapping costs—better and faster work—less tap breakage—the results of doing light tapping with a Burke Tapping Machine.

The operator simply places the work on the outside of the face plate and pushes it against the tap, thereby engaging the forward drive. When the tap reaches the proper depth, a slight pull on the work releases the drive and engages the reverse which backs out the tap leaving perfectly cut threads.

The output of a Burke Tapping Machine depends entirely upon the operator's ability to feed the work. These machines can also be used on lapping, burring, reaming, counterboring, assembling and similar operations where a friction drive is desirable.

Send for Details.

The Burke Machine Tool Company
516 Sandusky Street CONNEAUT, OHIO, U. S. A.

Buhr PATENT Multiple Drill Head

A simple attachment that will readily convert any single spindle drill press into a multiple drill. *Fully adjustable — ball bearing* spur geared—special arms for close center distances and many other features.

Let us give you figures.

The Buhr Machine Tool Co.
Greene and Davis Sts.,
ANN ARBOR, MICH.

Repeat Orders Tell The Story

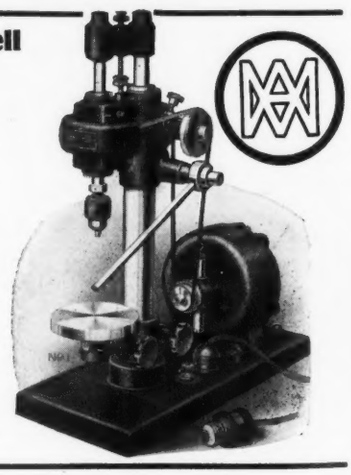
One A. M. Drill user writes:—"We consider that your drilling machine has the finest workmanship and finish of any machine tool in our shop—you'll receive another order from us for at least one more machine in the near future."

A few more concerns who sent in repeat orders are:—

Barber-Colman Co., Rockford, Ill. 6
L. G. Balfour Co., Attleboro, Mass. 9
Wadsworth Watch Case Co., Dayton, Ky. 12

More names sent on request. Write today for details.

Adolph Muehlmatt
Cincinnati, Ohio, U. S. A.



FOOTBURT

Footburt Sipp Sensitive Drilling Machine Line

Style DE

Drilling Range—3/16″ down to No. 80 drill.
7″ Overhang—Drills to center of 14″ circle.
Three speeds.
High or Low Speed Gearing.
Bench and Floor Types.
One, Two, Three, Four or Six Spindles.

Style BK

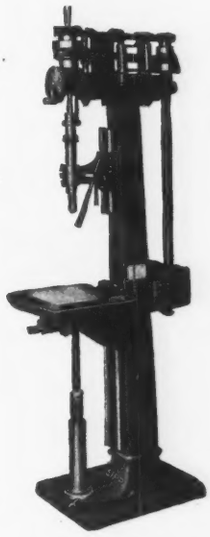
Drilling Range 5/8 in. down.
6½″ Overhang—Drills to center of 13″ circle.
Three speeds.
One, Two, Three, Four or Six Spindles.

Style BW & BX

Drilling Range 7/8 in. down.
BW has 8″ Overhang—Drills to center of 16″ circle.
BX has 12″ Overhang—Drills to center of 24″ circle.
Four speeds.
Automatic Power Feed Optional.
One, Two, Three, Four, Five, Six, Seven or Eight Spindles.

Footburt High Duty Line

This line of single spindle machines handles heavier drilling up to 5″ in solid steel. Multiple spindle work can be handled with independent feed drills or way drills built to fit your needs.



Style BK Single Spindle

One of the *FULL* line of Footburt Drilling Machines

Your drilling problems may be a matter of production or the necessity of having only one machine for many jobs. It may be the drilling of small holes or work up to 5″ in solid steel. It may be drilling one hole or one hundred holes in a single operation. Whatever your problem is, submit it to FOOTBURT. We will gladly give it careful consideration and make recommendations based on our thirty-four years of experience.

THE FOOTE-BURT COMPANY

Cleveland, Ohio

DETROIT OFFICE 4-151 General Motors Bldg.

FOOTBURT

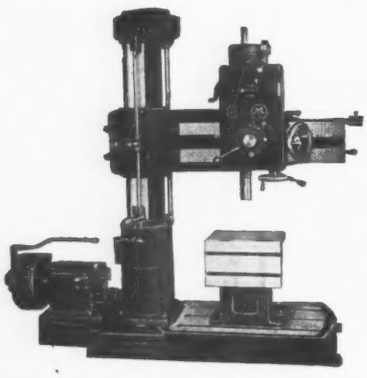
The New Dreses
Ball Bearing Multi-Duty
Radial Drill

See the New Safety Appliances and Time-Saving Devices

Safety Elevating Device — *Ball Bearings Throughout*
Simplified Forced Lubrication — *Frictions Run in Oil*
Enclosed Speed Box Runs in Oil — *Simplified Control*

The Dreses Machine Tool Company
Cincinnati, Ohio

Morris Radials



Better Production

Lower Upkeep

The advanced design of Morris Radials saves considerably on time costs by its exceptional convenience of operation.

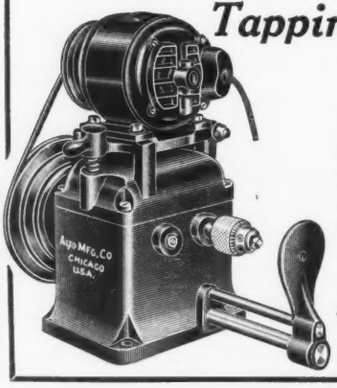
Multiple disc type frictions run in oil and can be easily adjusted from the outside of the casing. Speed box is of the sliding gear type and is equipped with ball bearings. The oil is properly distributed throughout the head from oil reservoir at the top of the head. It will pay you to get more details of Morris Radials.

Made in 2, 2½, 3, 3½, 4 and 4½ feet sizes. We also manufacture 16", 18" and 22" Cone and Geared Head Lathes.

Let us send catalogs.

The Morris Machine Tool Co.
CINCINNATI, OHIO, U. S. A.

The Alto No. 2 Motor Driven Tapping Machine—



with three correct speeds for driving taps ⅛" to ⅜" in any metal; with the greatest efficiency and without any danger of tap breakage or stripped threads. Self contained electric motor that plugs into any light socket for its current. Exceptionally moderate in price. We also make a smaller size motor driven tapping machine. May we send details.

ALTO MFG. CO.
1647-51 Wolfram St.
CHICAGO, ILL., U.S.A.

Kingsbury Automatic Sensitive Drilling Machines

ARE ENGINEERED COMPLETE TO SUIT your production drilling job. We specialize on work under ⅜" drill capacity. Write for catalogue.

KINGSBURY MFG. CO. KEENE, N. H.

Make your drilling profitable with

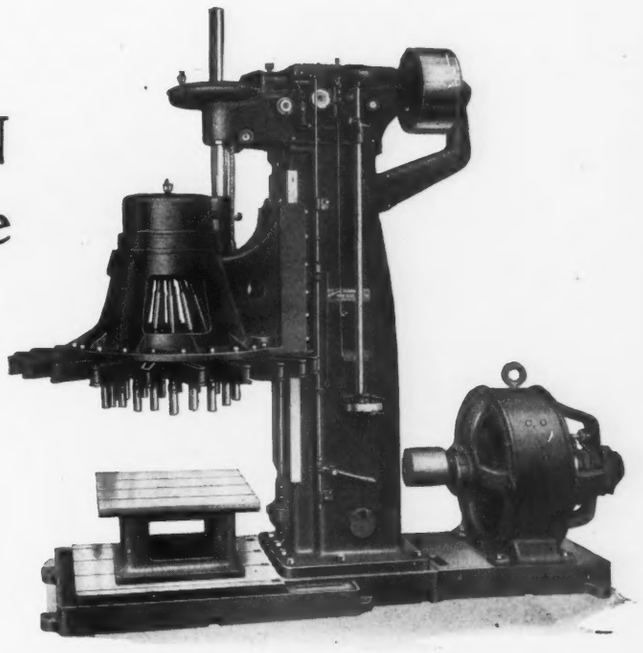
HŒFER DRILLERS

Take advantage of the "minute-saving" features of Hoefer Drillers and Auxiliary Heads.

HOEFER MFG. CO., Freeport, Ill.

HARRINGTON
Multiple Spindle Drills

All sizes, types and capacities

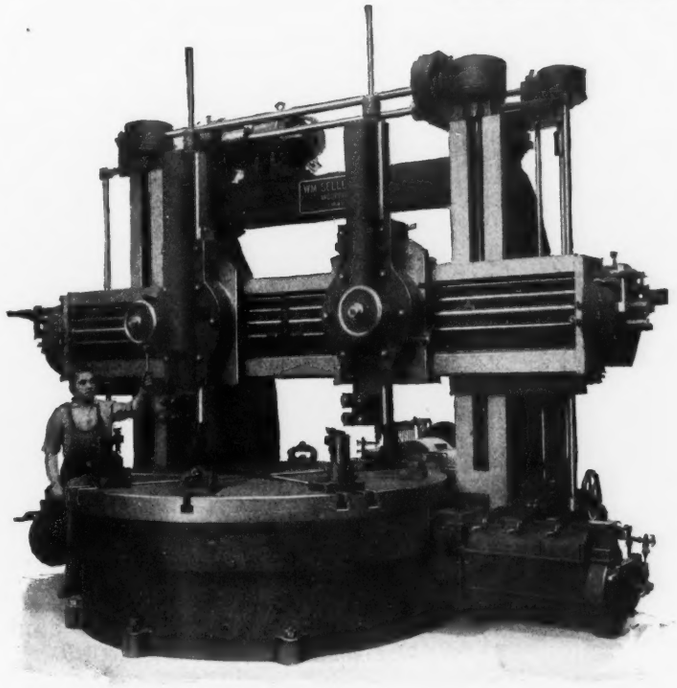


THE HARRINGTON COMPANY
PHILADELPHIA

William Sellers & Company Incorporated

1600 Hamilton St. **Philadelphia, Pa.**

Established 1848



LABOR SAVING MACHINE TOOLS

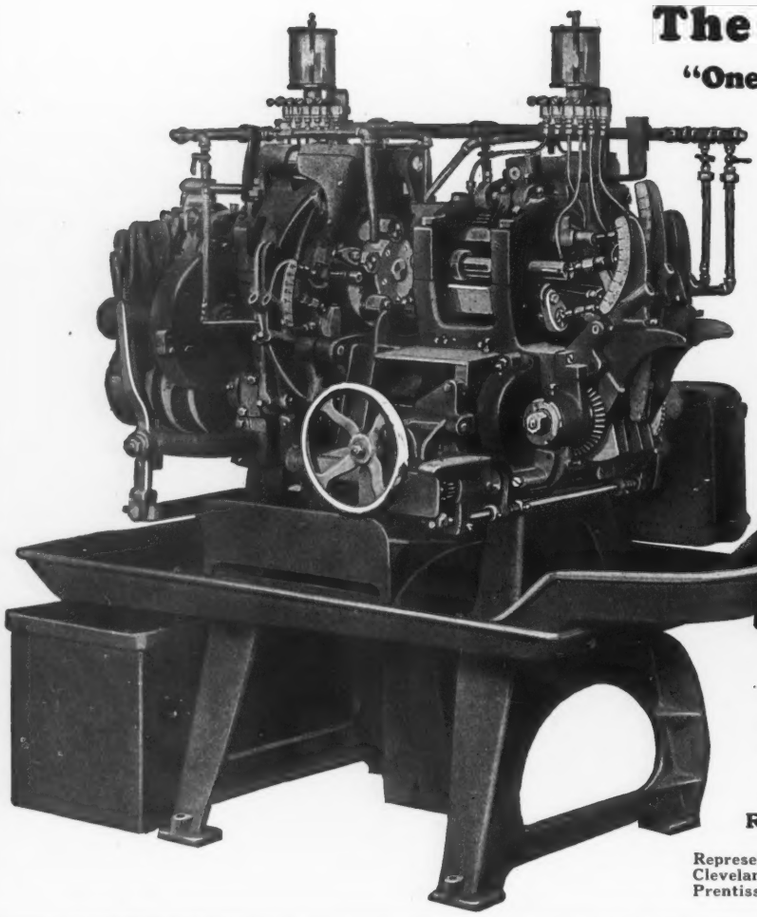
Boring and Turning Mills
Sizes 60 inches to 35 feet and over.

Abundant power, wide range of speeds and feeds, convenient arrangements for rapid manipulation, thus insuring largest output.

Self-contained
No expensive foundations

Always a prominent Sellers product.
First machine built in 1848.
Always ahead of demand.

TOOL GRINDING MACHINES
SHAFTING : : INJECTORS
DRILL GRINDING MACHINES



The DAVENPORT

"One Second" Automatic

Actual time on certain brass screw machine products, proportionate speed on all work. Five Spindles—no need to "crowd" the work—accuracy standards are easily maintained.

All the good points of the standard model 5 Spindle Automatic, with important improvements in design and construction that insure better work, greater profits.

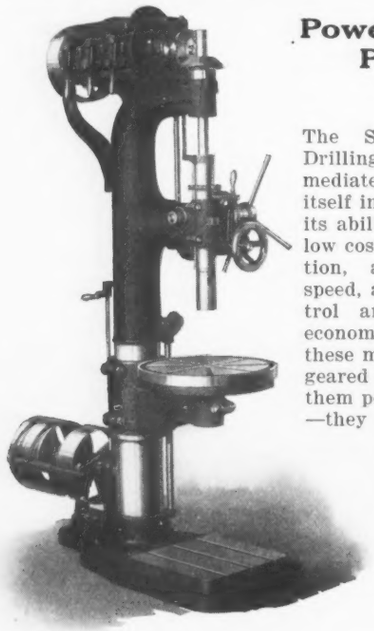
Send for details on this machine.

DAVENPORT MACHINE TOOL COMPANY, Inc.

ROCHESTER N. Y., U. S. A.

Represented by Motch & Merryweather Machy. Co., Cleveland, Cincinnati, Detroit, Pittsburgh. Henry Prentiss & Co., Inc., New York.

SIBLEY HI-SPEED MODEL "B"



Powerful Positive Productive

The Sibley Model "B" Drilling Machine will immediately earn a place for itself in your shop, through its ability to drill holes at low cost. Simple construction, ample power and speed, and convenient control are factors in the economical performance of these machines. Their all-geared construction makes them positive and accurate—they are equally valuable in the toolroom as for production.

Sibley Model "B" Drilling Machines are high production—low upkeep equipment of the most advanced type.

Bulletin on request

SIBLEY MACHINE COMPANY

8 TUTT STREET SOUTH BEND, IND., U. S. A.

U.S. Multiple Drill Head

With this simple attachment on your one-hole-at-a-time drilling machine you can drill two, six or a dozen holes in the time it takes to drill one, and at a fraction of the cost of a multiple spindle drill press.

Send blueprints or sketches for our estimate of the savings possible on your work.

United States Drill Head Co.

1948 W. Sixth Street, CINCINNATI, OHIO

Michigan Agents—National Sales Engrg. Corp., Detroit.

CARLTON RADIALS

Equipped With Ball Bearings Throughout

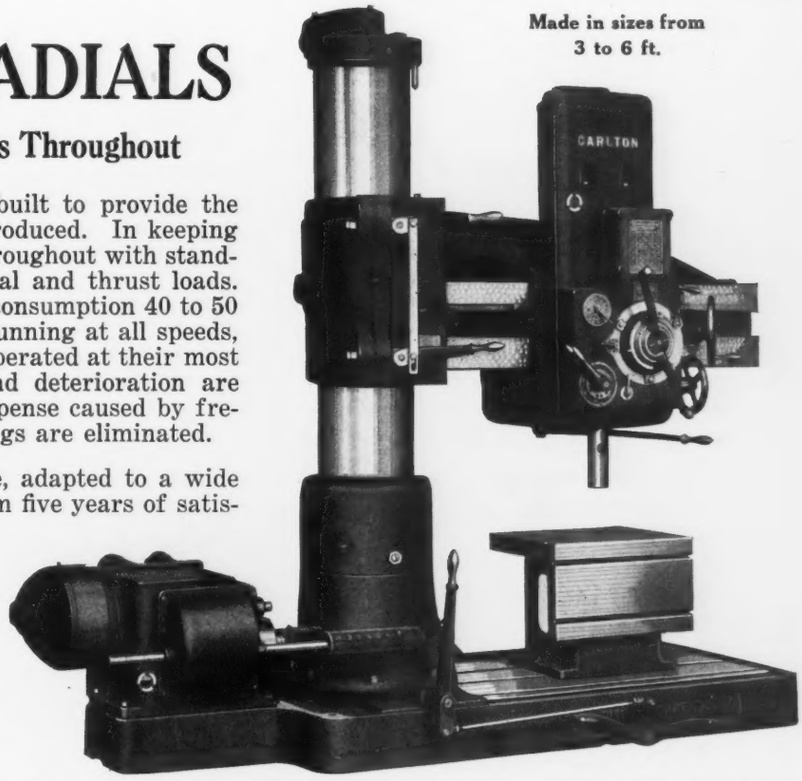
Carlton Radials are designed and built to provide the best drilling machine that can be produced. In keeping with this ideal, they are equipped throughout with standard ball bearings to take both radial and thrust loads. Reduction of friction lessens power consumption 40 to 50 per cent, makes the machine quiet running at all speeds, and enables high speed drills to be operated at their most efficient speed. Excessive wear and deterioration are avoided, and lost production and expense caused by frequent refinishing of ordinary bearings are eliminated.

Carlton Radials are easy to operate, adapted to a wide range of work, and have behind them five years of satisfactory service.

Where exacting conditions demand the utmost in drilling equipment, Carlton Radials have never failed to meet the test.

Catalog and list of users gladly sent on request.

Made in sizes from 3 to 6 ft.



THE CARLTON MACHINE TOOL COMPANY

Cincinnati, Ohio, U. S. A.

NATCO

Production Drilling and Tapping Machinery

MULTIPLE SPINDLE—ADJUSTABLE OR FIXED CENTER

HORIZONTAL DUPLEX

HEAVY DUTY SINGLE SPINDLE DRILL HEADS

NATCO-GARVIN-MINSTER

May we recommend the proper drilling and tapping equipment for low cost production

The National Automatic Tool Co.

RICHMOND, INDIANA

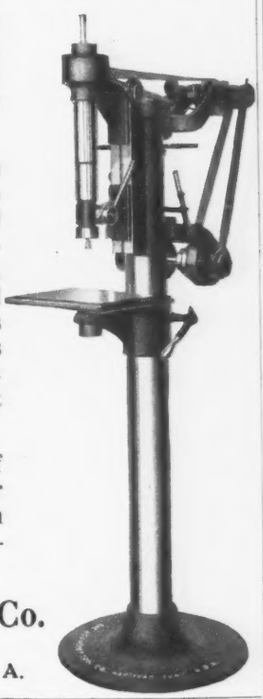
Sigourney Ball Bearing Sensitive Drill Press

3 Speeds up to 5,000 R. P. M.

The correct speed for fast and economical drilling in any metal is available with a Sigourney Sensitive Drill Press.

The One Spindle Type Machine has 2-5/16" vertical movement controlled by a lever; thrust is received on ball bearings. Also available in 2, 3 and 4 spindles. True to its name this machine is *sensitive*—the spindle responds to the slightest touch of the lever.

Complete information of this machine and our complete line of Plain Bearing Drill Presses—on request.



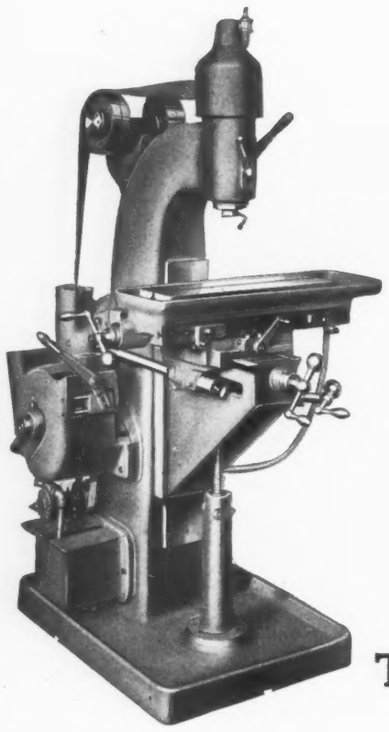
The Sigourney Tool Co.

11 Sigourney Street

HARTFORD, CONN., U. S. A.

Taylor & Fenn Vertical Milling Machines

38 Spindle Speeds
33 Power Feeds



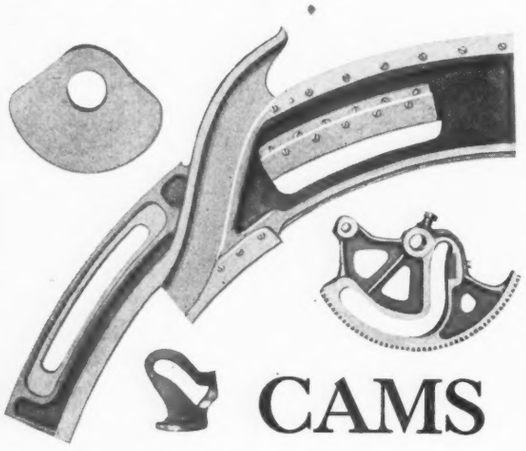
Ideally suited to do any light milling work within its range and with sufficient rigidity to stand the strains of heavy feeds and speeds. Speeds and feeds are variable over a wide range, assuring the greatest efficiency on each particular job.

All radial and thrust loads are carried on ball bearings, practically eliminating friction and vibration.

Designed for belt or individual motor drive, with regular or special equipment for many kinds of work. Send for details.

THE TAYLOR & FENN CO.
HARTFORD, CONN., U. S. A.

Kent-Owens



CAMS

For 30 years Kent-Owens has been building cams. These have covered a wide diversity in size and design. This experience qualifies us to build cams at the least cost.

Whether your requirements are for large quantities, or only a few cams we will submit prices promptly on receipt of your blue prints.

The Kent-Owens Machine Co.
958 Wall St., Toledo, Ohio

Facts and Figures

show that the rugged arch support of Briggs Millers is a decided mechanical advantage, the results of which are especially noticeable on the production cost cutting records.

The Briggs design increases output and permits heavy cuts to be taken at high speeds without "chatter".

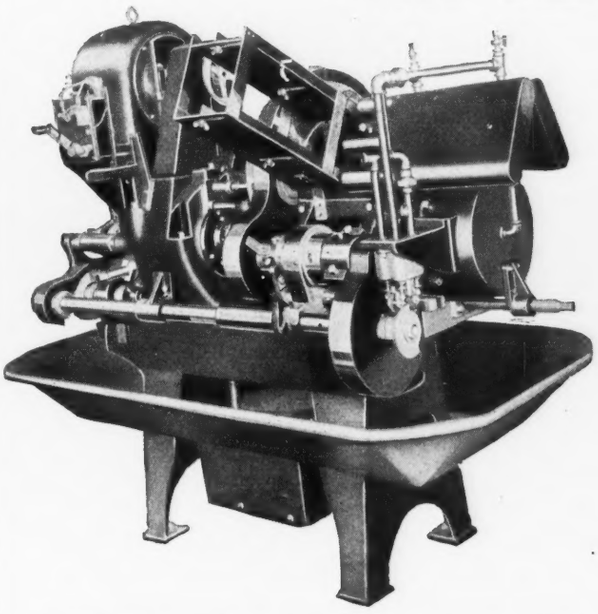
We will be glad to tell you how you can improve the quality and quantity of your work by installing Briggs Millers.

GOOLEY & EDLUND, Inc.
CORTLAND, N. Y.

U. S. HAND MILLERS
For all classes of light milling
U. S. SENSITIVE DRILLERS
For all classes of light drilling
SEND FOR CIRCULARS AND PRICES
United States Machine Tool Co. CINCINNATI, OHIO

Steinle Turret Machine Co.
THE FULL SWING SIDE CARRIAGE
TURRET LATHE
STEINLE TURRET MACHINE CO.
MADISON WISCONSIN U. S. A.

More Threads—Better Threads at Lower Cost



Pipe nipples, studs and any other small parts that must be handled in quantities can be threaded quickly and economically with a R-S Single Purpose Threading Machine. Entirely automatic, the operator simply feeds the work into two chutes which carry it to loading positions in air operated collets. The arrangement of these collets insures precise alignment of the work with the thread holding dies at all times.

A powerful oil pump is provided on the machine, which not only gives an ample flow of lubricant to the dies and work, but also washes the chips out of the threading dies at the conclusion of each operation. A specially designed friction clutch prevents damage to the machine in event of the work jamming.

Send for details or estimates of your work threaded on one of these machines.

RICKERT-SHAFER CO.

ERIE, PA., U. S. A.

OPERATORS DEMAND VAN NORMAN

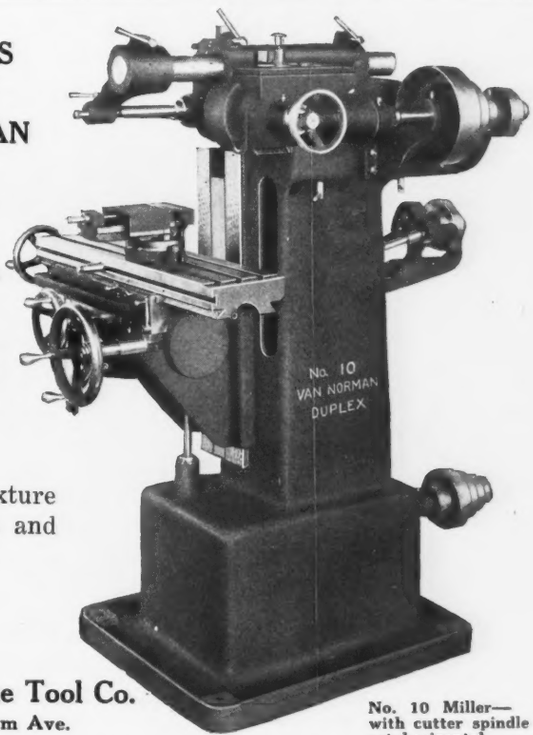
WHY?

Easy Set-Up Flexibility and Quick Changes of Operations

No. 10 Miller with cutter spindle set at an angle.

For Tool Room Fixture Gauge, Metal Pattern and General Utility work.

(Made in 5 Sizes)



No. 10 Miller—with cutter spindle set horizontal.

Van Norman Machine Tool Co.
150 to 200 Wilbraham Ave.
Springfield, Mass., U. S. A.

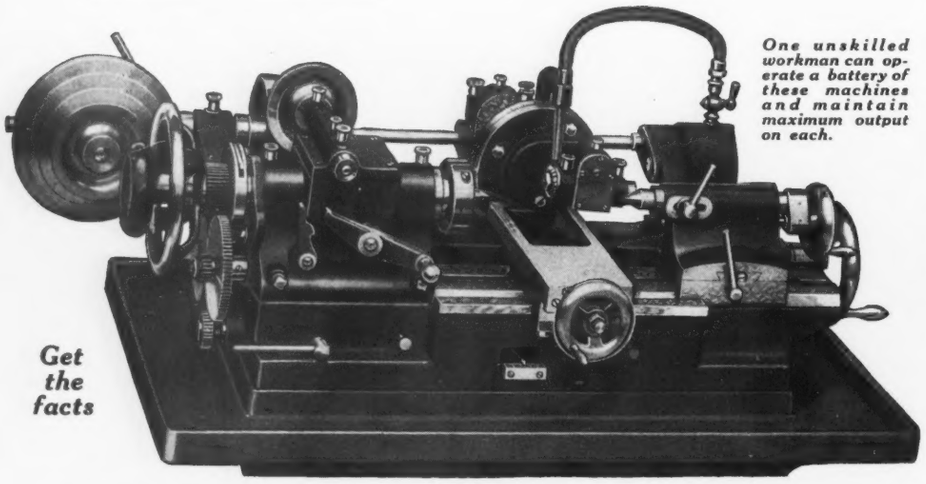
Van Norman Duplex Milling Machine

Waltham Thread Milling Machines

For Precision External or Internal Threading

WALTHAM
TRADE MARK
REGISTERED U.S. PAT. OFF.

Waltham Thread Milling Machines are rapidly making themselves indispensable in shops where they are installed for threading small parts on a quantity scale. Versatile and accurate in operation, adapted for cutting all kinds of threads—inch or metric pitch.



One unskilled workman can operate a battery of these machines and maintain maximum output on each.

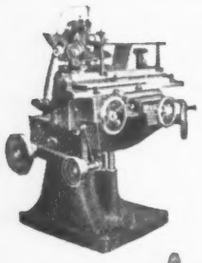
Easily set up. Longitudinal adjustment for duplicating threads already cut; taper attachment; index for cutting multiple threads; compensating bar to vary lead of thread and to make allowance for changes in hardness. Uniformity of size is easily maintained, as cutters will stand continuous service without frequent regrinding,—all are features of the Waltham Thread Milling Machine.

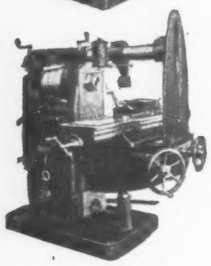
Get the facts

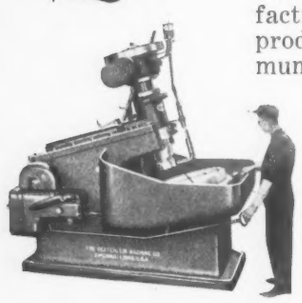
WALTHAM MACHINE WORKS, Newton Street, Waltham, Mass.

Makers of Small Thread Millers, Gear Cutters, and other Small Automatic Machines

Foreign Representatives: Buck & Hickman, Ltd., London. Fenwick Freres Co., Paris. Andrews & George Co., Tokyo, Japan. Andrews & George Co., Seoul, Korea. Andrews & George Co., Dairen, Manchuria.







Predictions—

as to the profits obtainable from installations on Ohio Production Equipment are based on reports of Ohio users on machines in operation.

"The Ohio Tool & Cutter Grinder—an efficient piece of tool room equipment that insures increased tool service."

"The Ohio constant Speed Miller—an accurate, versatile miller equally profitable on production or special work."

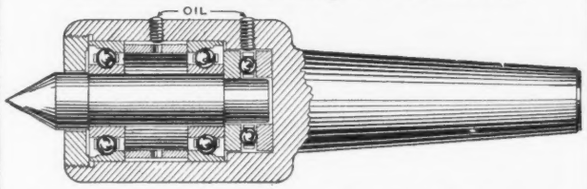
"The Ohio Tilted Rotary Production Miller—a manufacturing machine that cuts production costs to the minimum."

Send for details of Ohio Equipment

THE OESTERLEIN MACHINE CO.
3307 Colerain Ave.
Cincinnati, Ohio

OHIO

Send for the "ALIVE" Ball Bearing Center for 30 Days Free Trial



Get one of these improved "ALIVE" Ball Bearing Centers and see for yourself how it will improve the quality and speed of your production. Norma Ball Bearings carry radial and thrust loads. Write for circular.

Kell Manufacturing Co., 109 Tichenor St., Newark, N. J.

Multiple Spindle
Drilling and Tapping Machines
Flat Turret Lathes
Double End Shaft Turning Lathes
Special Machinery

GREENLEE BROS. & CO., Rockford, Ill.

GREAVES-KLUSMAN FLEXIBLE MOTOR-DRIVE GEARED HEAD LATHES

Spindle gears directly back of front spindle bearing, motor housed in leg, and other special features distinguish GK Lathes and provide better operation. Catalog on request.

THE GREAVES-KLUSMAN TOOL CO., Cincinnati, Ohio

Low Cost Cam Milling

Maximilling always brings low cost results and accuracy.

Tool-makers, machinery and fixture builders know the Maximiller is a necessity. It combines low-cost productivity with adaptability and accuracy.

The job shown produced 12 (perfect-to-master) cams per hour. A few changes and the machine was ready again for regular milling.

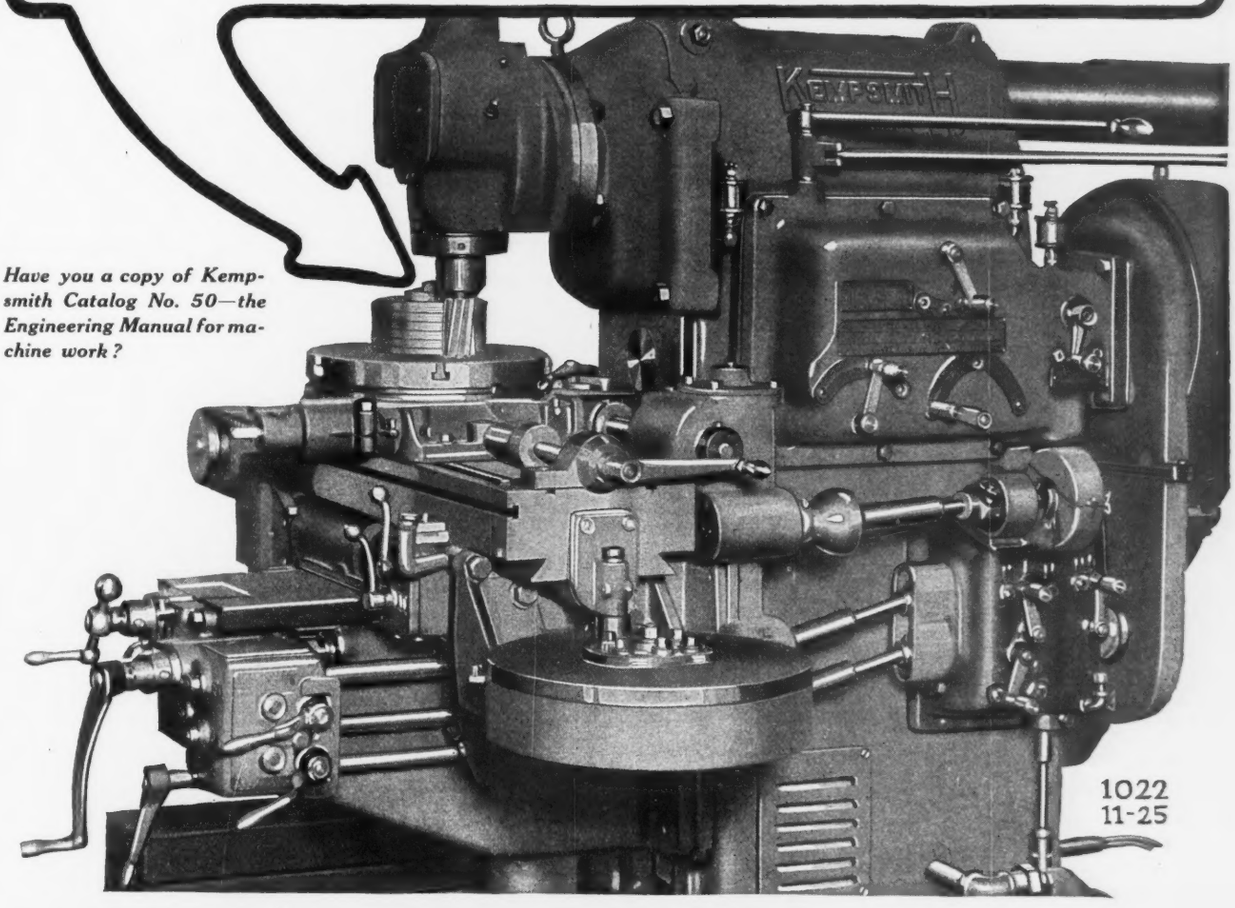
Maintenance costs were reduced by this machine—*a saving.* Speed production brought *another saving.* Adaptability to all-around finishing cut equipment expenditure—*still more saving.* Isn't that a profitable investment?

Send us your problem. The detailed estimate and suggestions we submit will show you that your production cost can be reduced by a Maximiller.

THE KEMPSMITH MANUFACTURING CO.

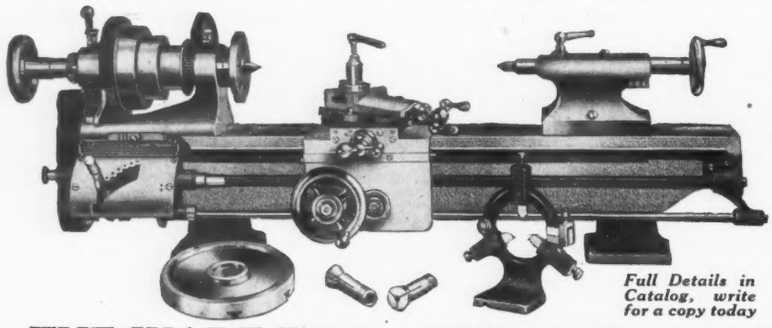
MILWAUKEE WISCONSIN

Have you a copy of Kempsmith Catalog No. 50—the Engineering Manual for machine work?



KEMPSMITH

Use Wade Lathes for Your Precision Work



Full Details in Catalog, write for a copy today

Besides the ordinary run of lathe work, attachments can be quickly applied that enable you to perform any conceivable operation to advantage.

Without equal in accuracy, selection of material and design for the work it has to do.

THE WADE TOOL COMPANY, 49-59 River St., Waltham, Mass.

Earning Money Everywhere

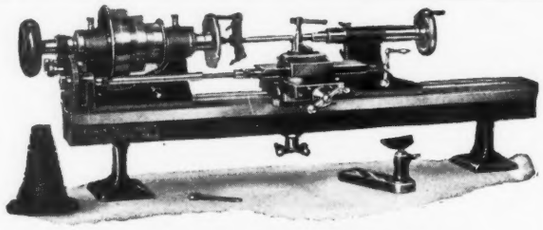
DAVIS KEYSEATERS in factories, in repair shops, in tool rooms—on all keyseating between the range of 1/16" and 1".

The "two minute set up" by reducing time between operations to the minimum makes these **production** machines on both short run and quantity operations.

Use Davis Keyseat Cutters on Davis Keyseaters. Send for details and price list.

Davis Keyseater Company

255 Mill Street, ROCHESTER, N. Y.



Almost a Complete Machine Shop

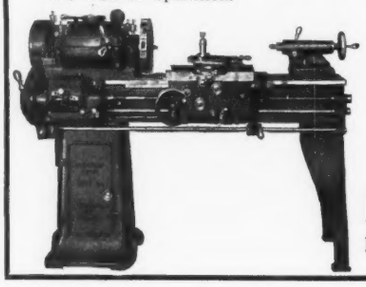
An Elgin Precision Bench Lathe with attachments is capable of turning, boring, drilling, milling, sawing, slotting, shaping, grinding, etc. Excels larger tools on production, is unexcelled for precision. Details on request.

ELGIN TOOL WORKS, Inc., ELGIN, ILLINOIS

Rockford "Economy" Lathes

speed up production on any work within their range—either toolroom, experimental or production jobs.

The quick change mechanism provides 32 feet and thread changes. Cut steel gears, large dust proof bearings, chasing dials and other features insure users of positive accuracy and ease of operation.



Let us tell you all the "economical" advantages of the "Economy" Lathe

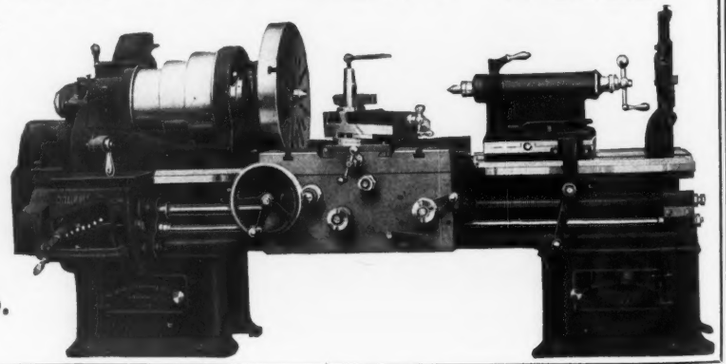
ROCKFORD LATHE & DRILL CO.

Rockford, Ill. U.S.A.

BRADFORD LATHES FOR HEAVY WORK

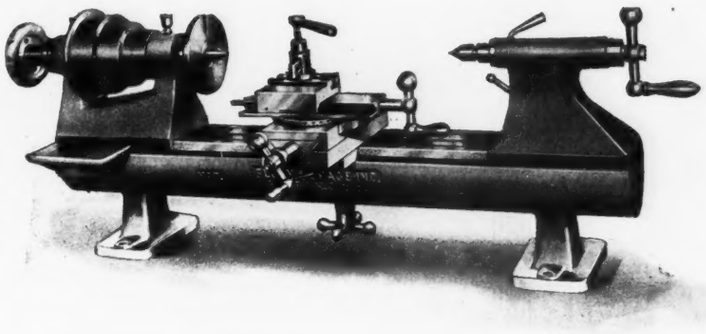
Heavy duty lathes are also an important part of the Bradford Line. Fast, accurate production machines, profitable on the shortest runs. Particular provision has been made to prevent springing and eliminate vibration, so the heaviest cuts may be taken without chattering. Dependable, long-lived, profitable.

Full details of the "Bradford" line on request — Engine, Precision, Turret Lathes—from 14" to 42" swing.



The Bradford Machine Tool Co.

CINCINNATI, OHIO, U. S. A.



A New Tool

SLOAN & CHACE No. 6

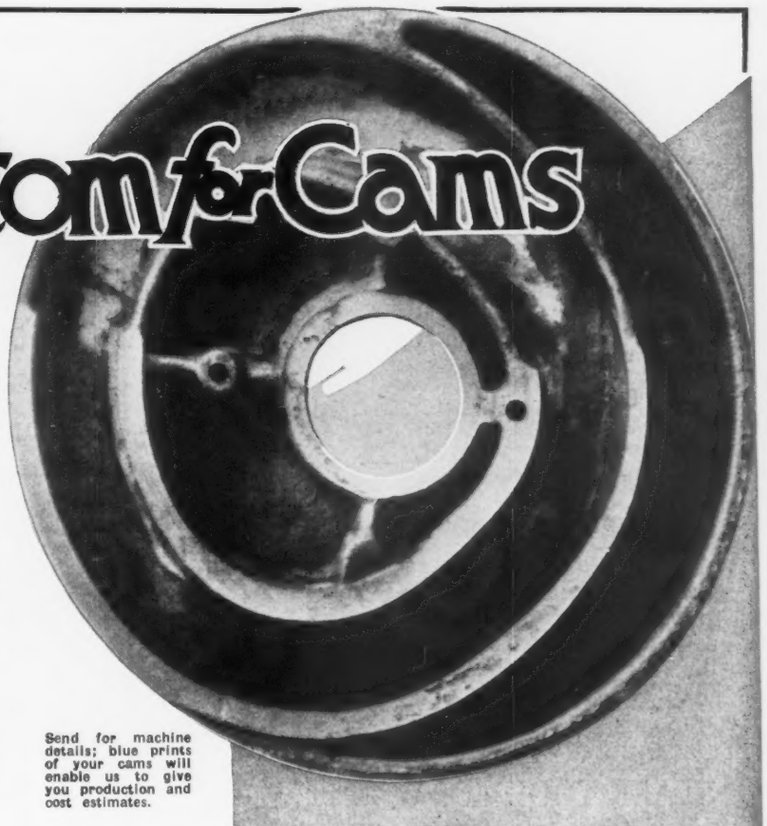
A Heavy Duty, Precision, Bench Lathe

Specifications:

10" Swing; ⅞" Collet Capacity; 1¼ Through Main Spindle, with draw-in Spindle removed; 38" Bed, Extra Rigid Construction.

SLOAN & CHACE, Inc., 351-365 Sixth Avenue, Newark, N. J.

Rowbottom for Cams



Economical, accurate production on these important parts

Large cams, small cams for all classes of automatics at prices hard to duplicate by other production methods.

Rowbottom Cam Milling Machines are simple, easily operated, accurate. Capacity: Box Cams to 32" diameter, Face Cams to 28" diameter, Barrel Cams to 24" diameter with 11" throw—special attachments or adjustments enable them to take care of larger sizes.

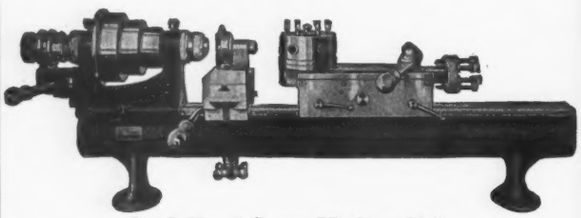
If you build automatics you will find a Rowbottom Cam Milling Machine a profitable installation—or we can supply your needs in our contract cam cutting shop.

Send for machine details; blue prints of your cams will enable us to give you production and cost estimates.

The Rowbottom Machine Co., WATERBURY, CONN., U. S. A. Factory: Waterville, Conn.

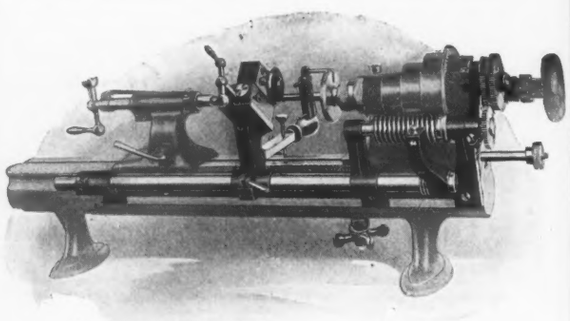
Stark Precision Bench Lathes

and Attachments



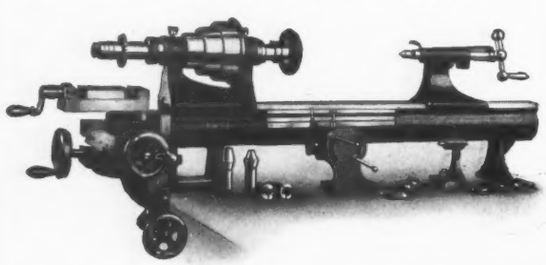
Stark No. 4 Screw Machine Unit.

For small lot production of very precise work you can't beat this combination—a plain lathe fitted with Lever Chuck Closer, Cutting-off and Forming Rest and Automatic Turret. Built in four other sizes.



Stark No. 4 Lathe with Screw Cutting Attachment

Accurate threads of ordinary pitches from four to ninety per inch and of any form may be cut with the regular gears and lead screws, and ground by use of the Stark Grinding Attachment. Special and metric lead screws can be furnished to order.



Stark No. 4 Lathe With Milling Attachment

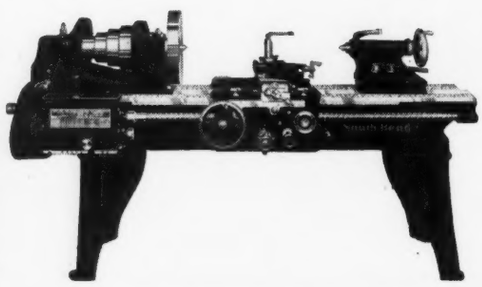
A real milling machine in connection with the lathe makes it an ideal unit for tool room use. May be equipped with vertical attachment and with plain or universal index centers which take the same collets used by the lathe.

We have your catalog ready.

STARK TOOL CO., Waltham, Mass.

Established 1862

Originators of the American Bench Lathe



18 inch x 10 foot Quick Change Gear Screw Cutting Lathe, $746

Write for this Catalog

SHOWS 96 styles and sizes of Lathes, Motor Driven Lathes, Bench Lathes, Gap Bed Lathes, and Important Attachments.

The New South Bend Lathe

A heavier, stronger Lathe of greater belt power—and many other improvements makes this a very attractive and unusual lathe value.

NET Factory Prices

Quick Change Gear Lathes

11 in. x 4 ft.	$308
13 in. x 5 ft.	$387
15 in. x 6 ft.	$468
16 in. x 8 ft.	$553
18 in. x10 ft.	$746

Precision and Accuracy

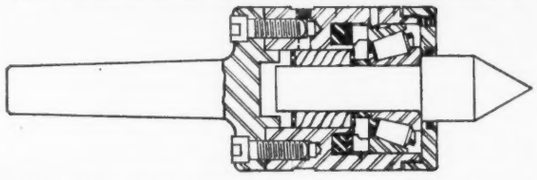
The repetition of 44 tests by precision instruments insures the accuracy and interchangeability of each part of the New South Bend Lathe.

Easy Payments if Desired. Write for Catalog.

South Bend Lathe Works

725 East Madison St., South Bend, Ind.

Friction-less Live Centers

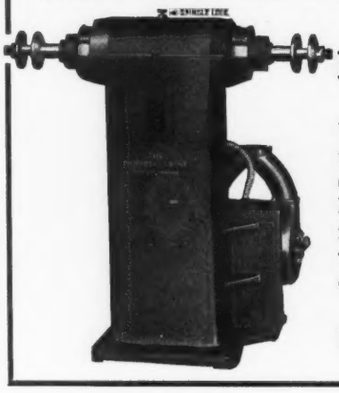


Eliminate center trouble. Types and sizes to meet all requirements. Made to wear. Indispensable on production work. Tell us your center troubles and we can show you how to get rid of them. Send for circular.

PRECISION GAUGE & TOOL CO.

6482 Epworth Blvd., DETROIT, MICH.

SELECTIVE SPEED



Motor Driven Polishing Lathes

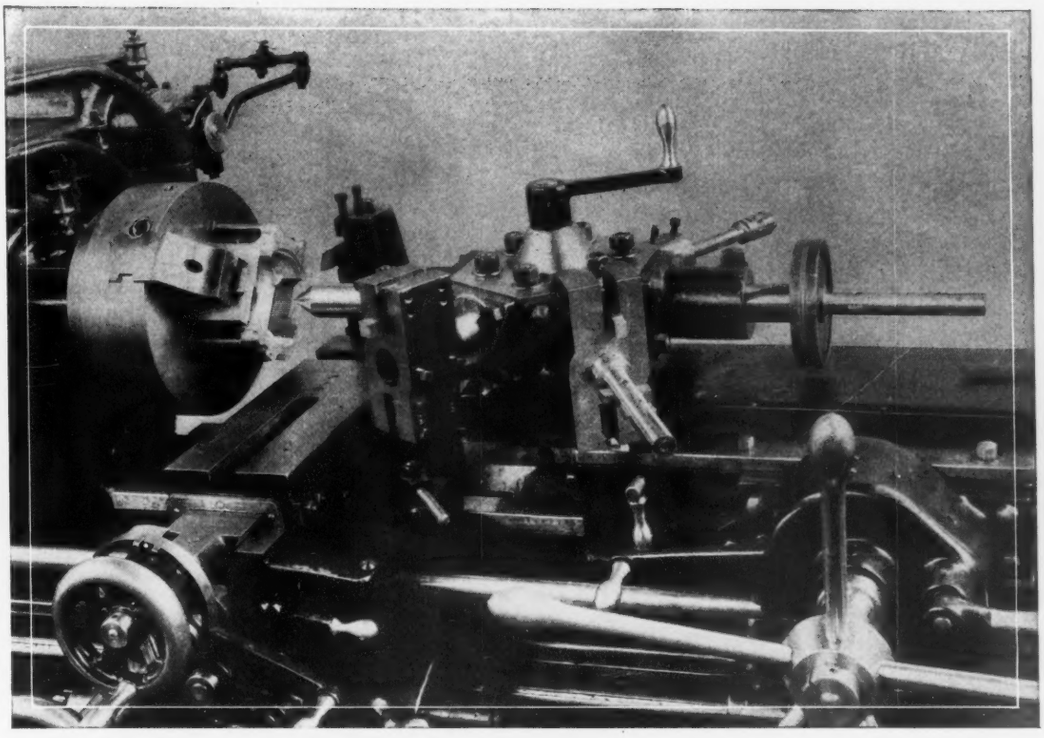
Ball Bearing

We can give you the most efficient spindle or wheel speed regardless of the motor speed made in sizes from 3 to 15 H P., single and double spindle.

THE MITCHELL ENGINEERING CO.

SPRINGFIELD, OHIO

135 Pieces a Day~ *Day after Day!!*



A No. 4B Universal at work on a crank case with the above record.

the Output of a GISHOLT Small Turret Lathe

Producing every minute—each piece finished to pass rigid inspection—that's the kind of work turned out by this No. 4B Universal.

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT. 20-24
BOOTH NO. 272

The same service is obtained from the other sizes of Gisholt Small Turret Lathes—and there are sizes for your requirements.

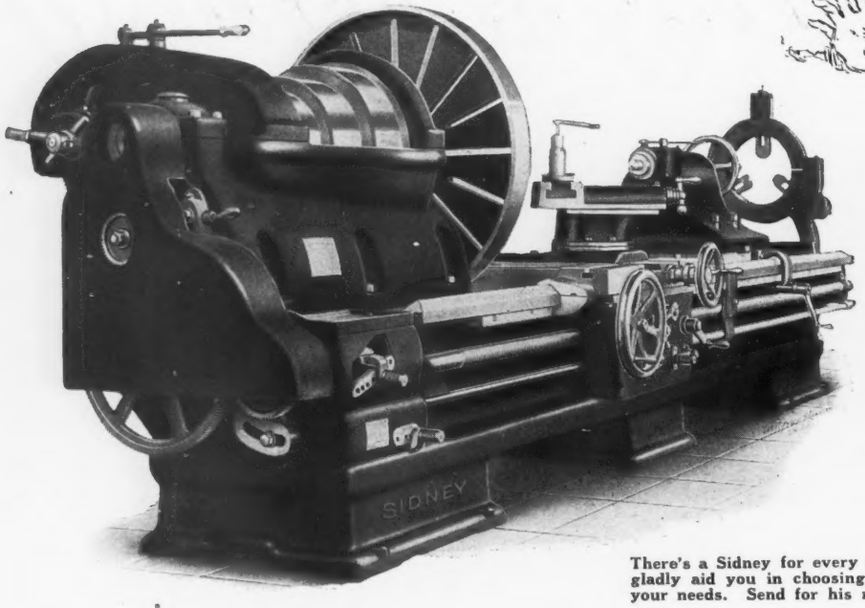
Your prints will help us tell you the rest of the story.

—and we have a Small Turret Lathe catalog. Write for it.

GISHOLT MACHINE COMPANY
1300 E. WASHINGTON AVE., MADISON, WIS.

Sidney Lathes for every purpose

Sid says,— *"I see the boss has bought a new car;— must be that those new Sidneys are makin' money for him, cause 'fore we got 'em he couldn't even buy gas for his old flivver."*



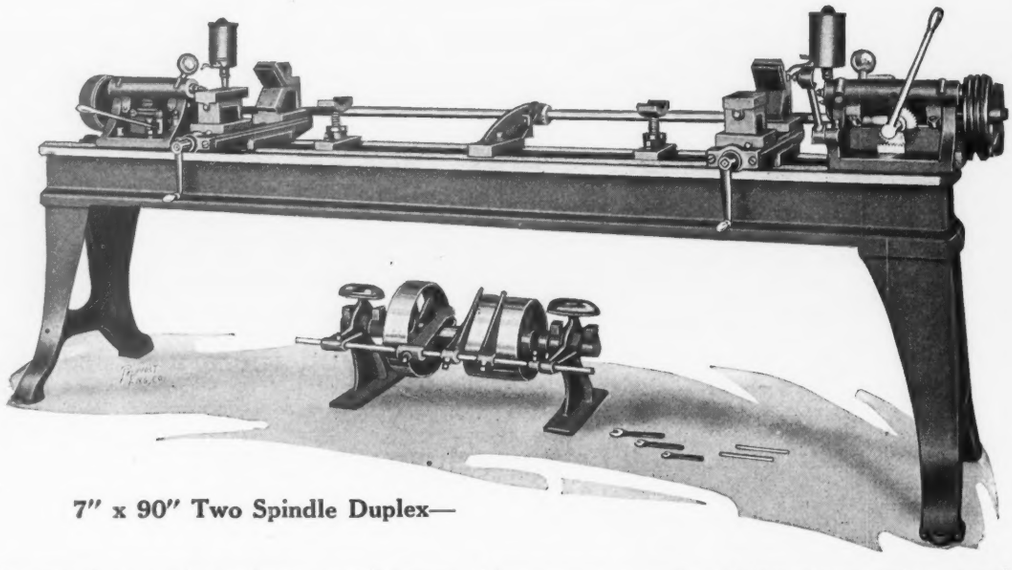
And Sid, being a seasoned mechanic, knew that the lathe end of the shop had been inefficient—in fact it was he who recommended Sidneys as the remedy for the poor lathe production. Sid had worked with Sidney Lathes before and he knew the stuff they are made of and as he told the boss when they were "shopping" for new machines,—"Boss, I've worked on Sidneys and I know what they'll do, but you don't have to take my word for it—ask anyone that's got Sidneys". The Boss did—and that is how his profits bought a new car.

There's a Sidney for every class of lathe work, and a Sidney dealer will gladly aid you in choosing the size and type equipment to best meet your needs. Send for his name—and for complete catalog.

THE SIDNEY MACHINE TOOL CO., Sidney, Ohio

Center both ends at the same time—

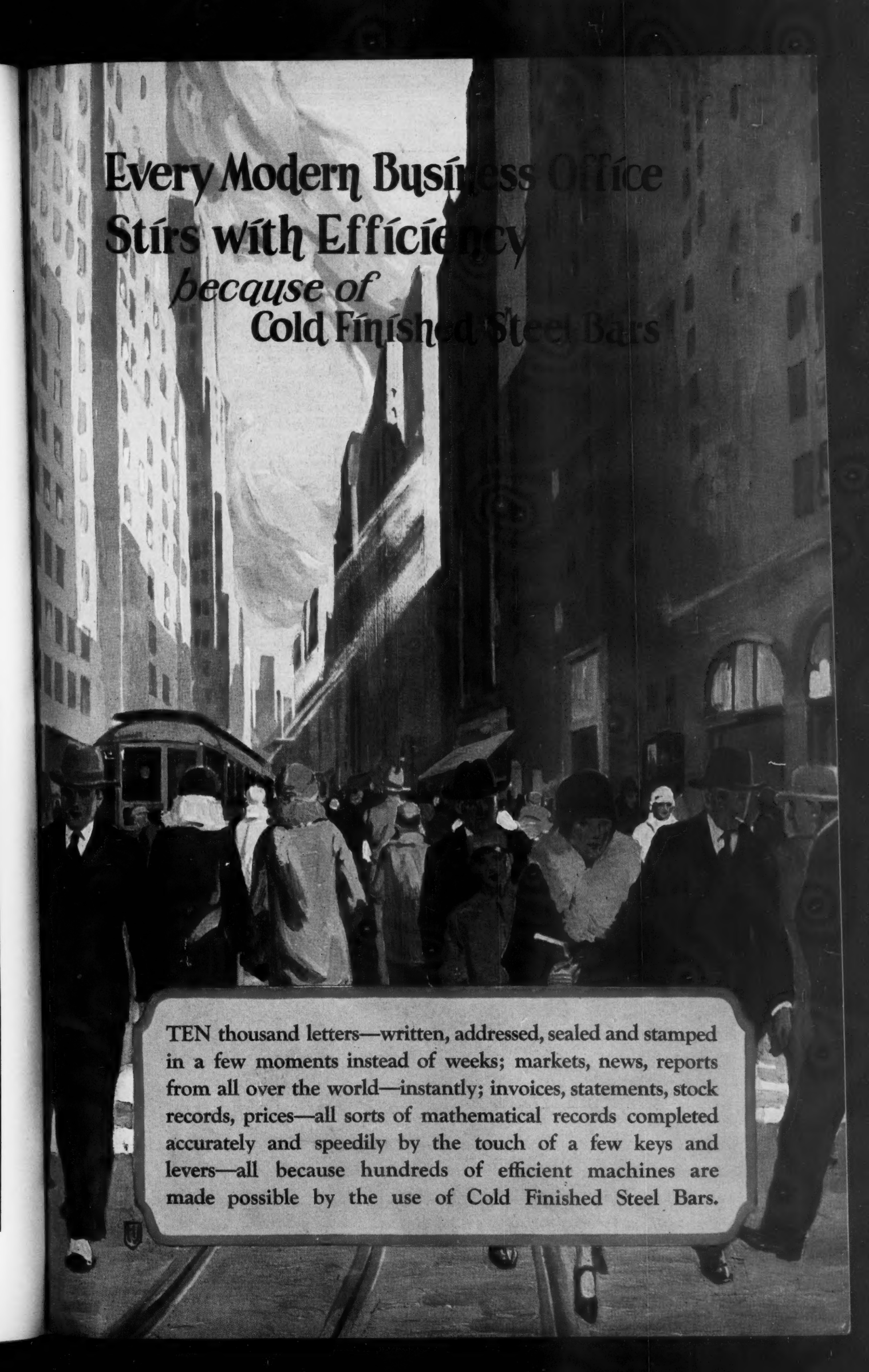
Whiton Duplex Centering Machines



7" x 90" Two Spindle Duplex—

For centering car wheel axles and similar types of heavy work as well as lighter pieces, such as camshafts and crankshafts. This machine is accurate and convenient. It centers both ends of the work at one setting; center-drills both ends at one operation and countersinks both ends at the same time.

THE D. E. WHITON MACHINE CO., New London, Connecticut



TEN thousand letters—written, addressed, sealed and stamped in a few moments instead of weeks; markets, news, reports from all over the world—instantly; invoices, statements, stock records, prices—all sorts of mathematical records completed accurately and speedily by the touch of a few keys and levers—all because hundreds of efficient machines are made possible by the use of Cold Finished Steel Bars.

The Vital Parts of Modern *Office Equipment* are made from Cold Finished Steel Bars

Up-end your typewriter, probe into its internals. Out of the clutter of strip steel, the stampings, the castings, the forgings, will shine scores of small, smooth-finished parts of steel. The spindle on which the platen turns, the long rods of the carriage assembly, the guides, the tabulating scales, and literally hundreds of screws, bolts, nuts, set screws, pivot screws, cap screws, lock nuts, collars and pinions are made from Cold Finished Steel Bars. All are smooth, accurate, readily made, economically produced on high speed automatic machines, at a cost which makes your typewriter possible at a profit to its maker.

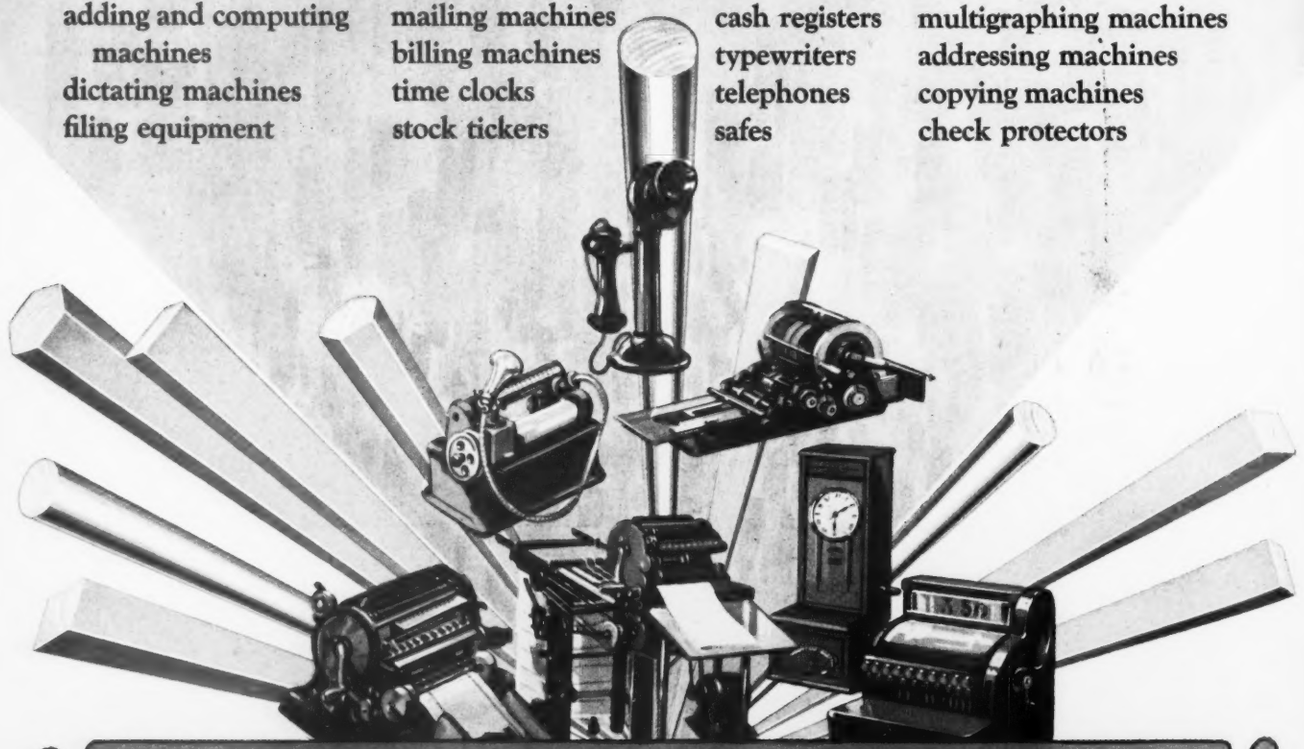
In the same way your computing, addressing, mailing machines, stock ticker, telegraph, telephone — all depend for vital parts upon the Cold Finished Steel Bar Industry—*the Industry within an Industry.* The very transaction of business hangs upon the Industry that finishes rough hot rolled bars accurately to meet the most exacting requirements of all manufacturers.

It is the purpose and the hope of this Industry to secure to manufacturers of this class of equipment still greater economies and advantages through a larger use of Cold Finished Steel Bars.

This is but one of the many branches of Industry dependent upon the use of Cold Finished Steel Bars for the economical production of small parts.

A few of the Hundreds of Business Office Appliances, many parts of which are made from Cold Finished Steel Bars

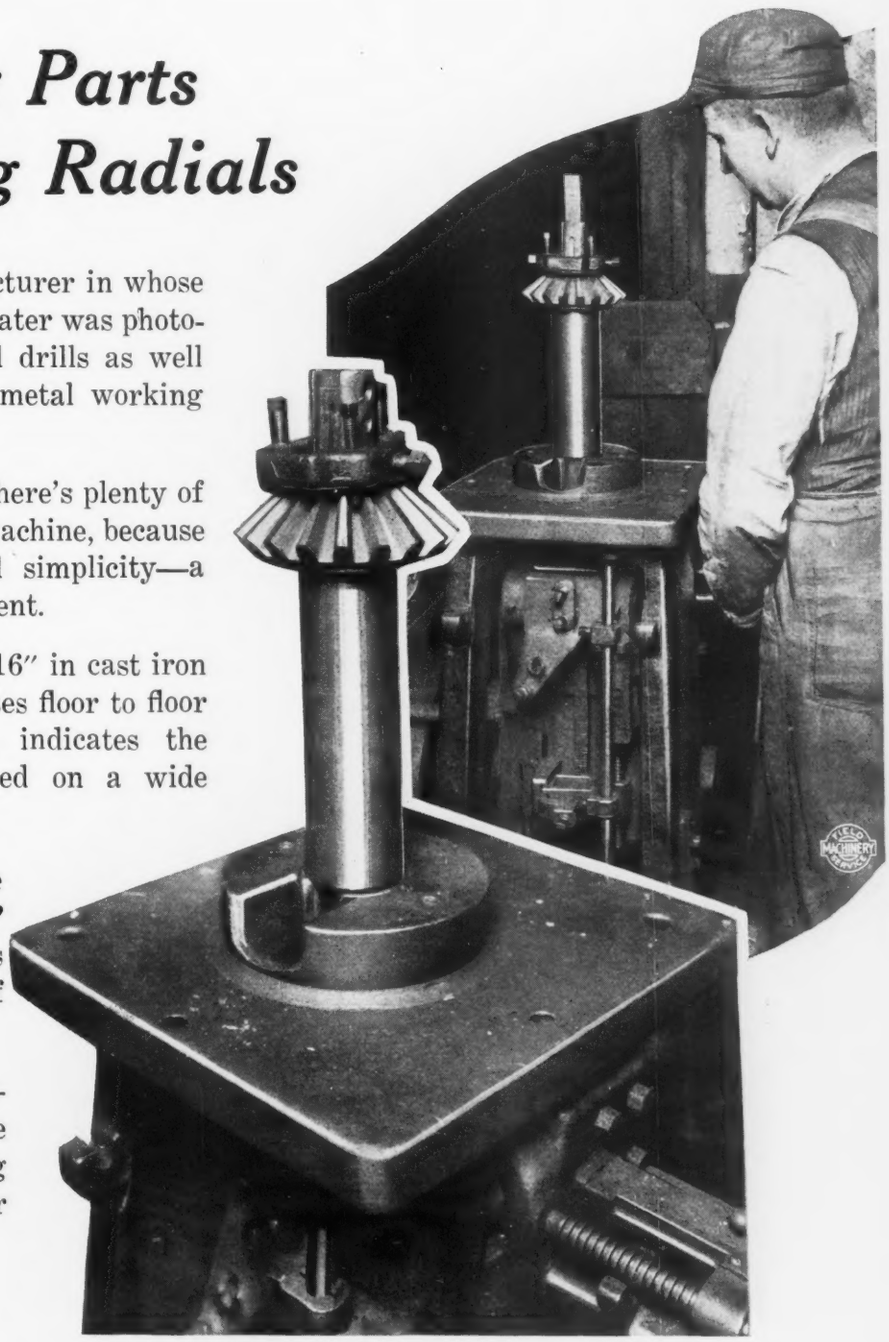
adding and computing machines	mailing machines	cash registers	multigraphing machines
dictating machines	billing machines	typewriters	addressing machines
filing equipment	time clocks	telephones	copying machines
	stock tickers	safes	check protectors



The Cold Finished Steel Bar Industry

The "GIANT" Keyseater

Keyseating Parts for Big Radials



The machine tool manufacturer in whose plant this **"GIANT"** Keyseater was photographed builds big radial drills as well as a large line of sheet metal working machines.

All the keyseating—and there's plenty of it—is performed on this machine, because of its power, speed and simplicity—a valuable piece of equipment.

This keyway, .375″ by 3/16″ in cast iron is completed in five minutes floor to floor —production time that indicates the profitable service obtained on a wide range of work.

"GIANT" Keyseaters are always busy. **"GIANT"** Keyseating is always profitable on all classes of work.

We can show you interesting service records, quote upkeep and operating costs that apply to your product.

Eight sizes—write for details.

MITTS & MERRILL

843 Water Street **SAGINAW, MICH.**

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Oslo, Norway and Stockholm, Sweden.

THE MORTON TRAVELING HEAD ROLL WABBLE PLANER

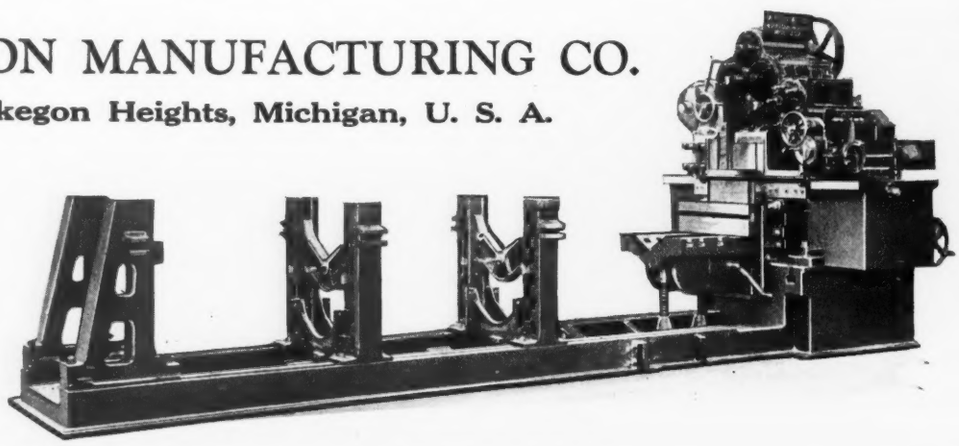
A typical Morton production machine for accurately machining the wabble ends of any type rolls up to 56″ diameter, 28″ diameter neck, any length.

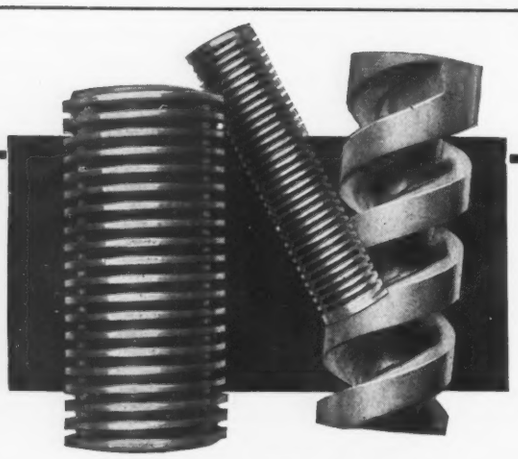
Bed swings on trunnions to obtain tapers up to 1½″ per foot. Rigid set up for the work, accurate adjustment for machine head, etc., insure accuracy and permit speed in operation.

MORTON MANUFACTURING CO.

Muskegon Heights, Michigan, U. S. A.

Send for Details of this New Morton Machine





HINDLEY

Power, Lead and Feed Screws

We have the special machinery necessary to produce screws of all sizes and types, any length, any diameter. Hindley Screws are superior in accuracy, strength, and wearing quality, because our method of cutting disturbs metal structure least.

Try a Hindley Screw where wear and breakage are heaviest—that is where they show up best.

Let us estimate for you

HINDLEY GEAR COMPANY

1107 Frankford Avenue, Philadelphia, Penna.

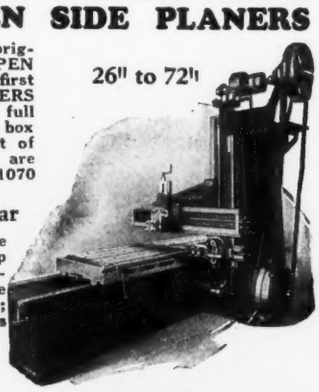
CLEVELAND OPEN SIDE PLANERS

Permanency was built into the original design of CLEVELAND OPEN SIDE PLANERS. When the first CLEVELAND OPEN SIDE PLANERS were built with closed top Bed, full depth sides, full box Column, and box Girder Knee, they attracted a lot of attention. All of these features are commonly used today. Over 1070 installations.

Send for descriptive circular

Power Rapid Traverse; Single Turn Rail Clamp; Automatic Trip to Rail Raising Mechanism; Improved Head Clamp; Herringbone Gears on Intermediate Reduction; Forced Feed Lubrication to Vees if desired.

26″ to 72″



The Cleveland Planer Co.

Established 1900

3148 Superior Avenue
CLEVELAND, OHIO

Shapers Exclusively

Crank Sizes: 12″, 14″, 16″, 20″, and 25″—Either Cone Driven or through Speed Box, 32″ B. G. All Geared Single Pulley Drive

THE SMITH & MILLS COMPANY

CINCINNATI **OHIO, U. S. A.**

FLATHER LATHES

HIGHEST GRADE FOR TOOL-ROOM AND MANUFACTURING PURPOSES

The Flather Company, Nashua, N. H.

Planers That Reduce Costs

Full Housed and Open Side Types. Let us send complete details.

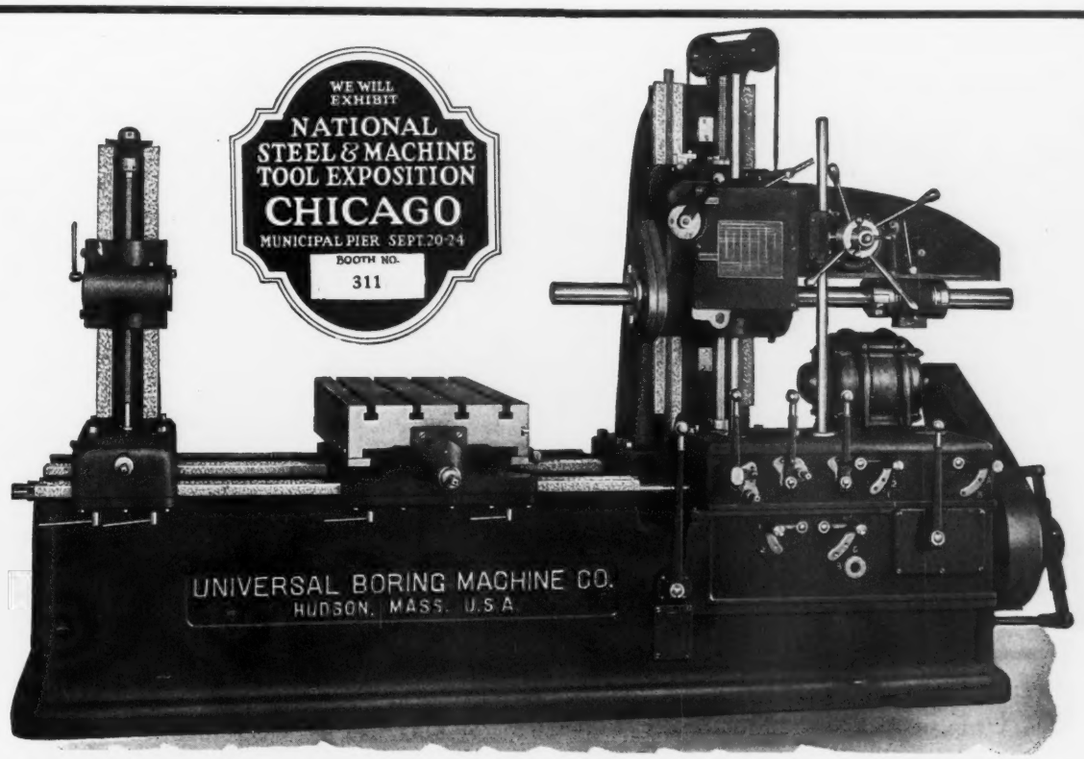
Note the extraordinary rigidity of the cross arm.

New ideas in construction make Liberty Planers economical in operation and upkeep and save valuable minutes of production time. That is why Libertys reduce planing costs per piece to the lowest possible limit.

The purchase of a Liberty affords the utmost in service a planer can give—a continuous source of profit and satisfaction.

THE LIBERTY MACHINE TOOL COMPANY

Hamilton, Ohio

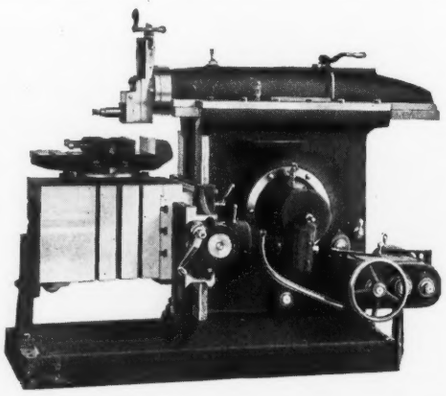


Number 24 Tri-Way with 2½ inch main Boring Bar

The Greatest Advance in Horizontal Boring Machine Design in Twenty Years

UNIVERSAL BORING MACHINE CO., Hudson, Mass., U. S. A.

Columbia Superior Shapers Satisfy Operator and Boss



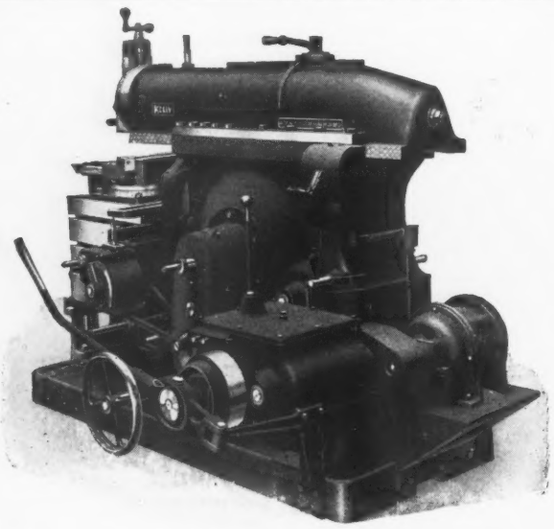
Whether as production, tool room or general purpose machines Columbia Heavy Duty Shapers invariably reduce costs because of their rapid operation, low maintenance cost and time-saving features.

They are built to perform the heaviest cuts as easily and accurately as the lightest, and cover the whole range of work a shaper can take care of, with unvarying efficiency and satisfaction.

Columbia Superior Shapers are popular alike with operator and the "boss" —because they work well and work profitably.

The Columbia Machine Tool Company, Hamilton, Ohio

Manning, Maxwell & Moore, Inc., Selling Agents, New York City and branches—Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Syracuse.



Kelly Crank Shapers

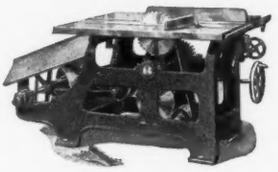
The Kelly Crank Shaper is a productive cost cutter because it is highly accurate, dependable and unusually speedy. These characteristics are largely due to the special construction of the ram, which is unusually heavy and powerful, and will not jam. Ram return is unusually fast, and the length of stroke may be changed instantly while at rest or in motion.

This same painstaking care has been applied in building every part of the Kelly, making it a machine of exceptional character. Catalog on request.

The R. A. Kelly Company

XENIA *Makers of Crank Shapers Only.* **OHIO, U. S. A.**

Crescent Wood Working Machinery

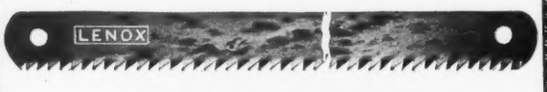


is popular because the machines are durable and always please our customers. You will eventually need additional equipment to help you speed up production so you would better plan a little ahead of your requirements and ask for circular of machine you may need in future.

The Crescent line consists of band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood worker, hollow chisel mortiser, universal wood workers, table cut off saw, single end tenoners, self feed rip saw.

The Crescent Machine Co., 56 Main St., Leetonia, Ohio

QUALITY UNIFORMITY **"LENOX"** HIGH SPEED SERVICE DISTINCTION

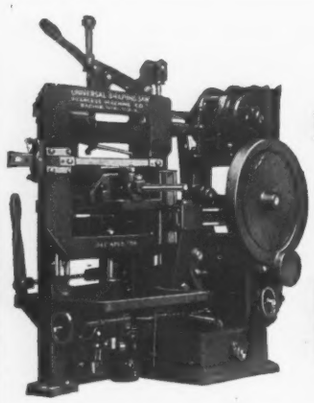


HACK SAWS

"The Tools in the Plaid Box"

AMERICAN SAW & MFG. CO. SPRINGFIELD, MASS.

HACK SAWS – BAND SAWS – SCREW DRIVERS – GLASS CUTTERS



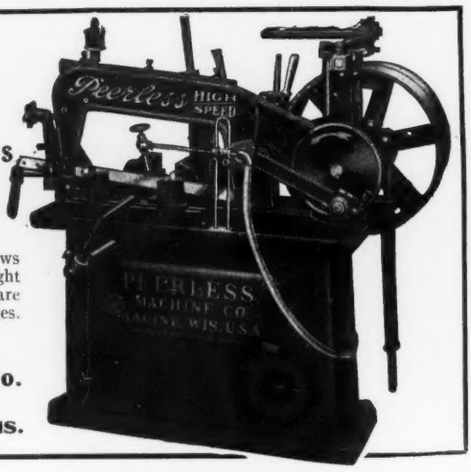
Peerless

High Speed Metal Sawing Machines

Peerless Cutting-Off Machines cut to such close limits that they effect big savings in material that formerly found its way to the waste pile.

WE WILL EXHIBIT NATIONAL STEEL & MACHINE TOOL EXPOSITION CHICAGO MUNICIPAL PIER SEPT. '20 TO '24 BOOTH NO. 128

Illustration at the left shows the 6" "Universal"; at the right the 6" Peerless. Both types are made in 9" and 13" capacities. Send for details.



Peerless Machine Co.

1611 Racine Street

RACINE WIS.

How Many Teeth Do You Need In a Hack Saw Blade?

For economy in metal-cutting select the Hack Saw Blade best suited to your work. If it is a Simonds High Tungsten Blade you are first assured of more service. After that the right number of teeth for different classes of cutting is the only question. For cutting cold rolled steel select a coarse tooth blade, such as 14, 12 or 9 teeth per inch. Be sure it is a *Simonds All Hard Blade* for power use.

For general hand use, cutting tool steel, iron pipe, hard metals, light angle iron, etc., use *Simonds Hard Edge* Non-breaking Blades, 18 teeth to the inch.

To get the best results in cutting thin metals, thin tubing, etc., demand the fine tooth Simonds Hard Edge Blade, one containing 24 or 32 teeth to the inch.

Buy your Hack Saw Blades with care. Get the best. They cost no more but give longer service.

Write for a free copy of "Hacksawology" containing many valuable hints.

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NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
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BOOTH NO. 212-16

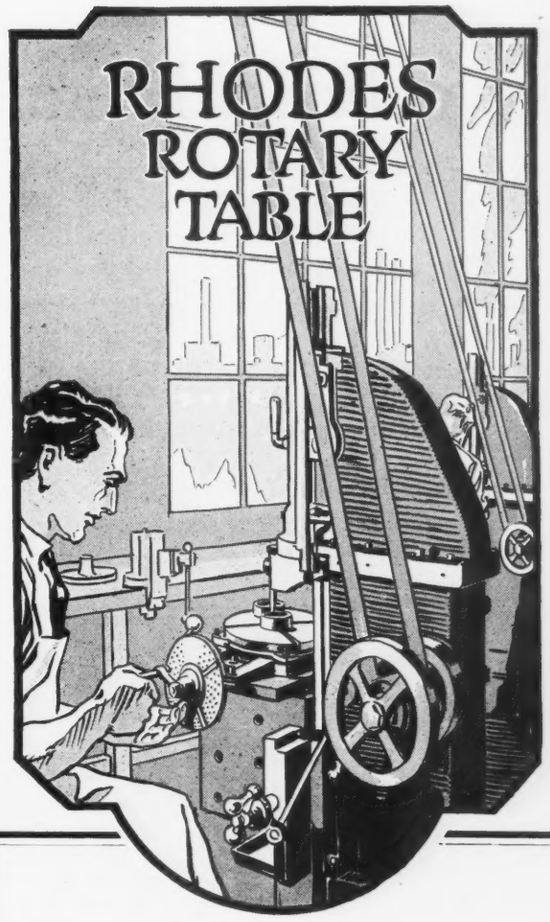
SIMONDS SAW AND STEEL CO.

FITCHBURG, MASS. CHICAGO, ILL. BOSTON, MASS. DETROIT, MICH. NEW YORK CITY. LOCKPORT, N.Y. MEMPHIS, TENN. NEW ORLEANS, LA. LONDON, ENGLAND PORTLAND, ORE. SAN FRANCISCO, CAL. SEATTLE, WASH.

SIMONDS CANADA SAW COMPANY, LTD.
MONTREAL, QUE. ST JOHN, N.B. TORONTO, ONT. VANCOUVER, B.C.

Makers of

Hack Saws, Metal Band Saws, Inserted Tooth Metal Saws, Solid Tooth Metal Saws, Slitting and Slotting Saws, Files, Tool Bits.

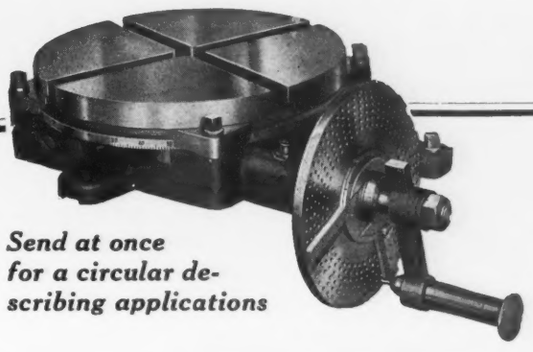


The Device That Makes Circles and Angles Easy

The Rhodes Rotary Table can be attached to any miller, slotter, drill press, grinder or shaper, and can be moved from one machine to another without resetting the work. The machining of curves, angles and the intricate contours of odd shaped parts can be done with precision and considerable ease when the piece is mounted on a Rhodes Rotary Table.

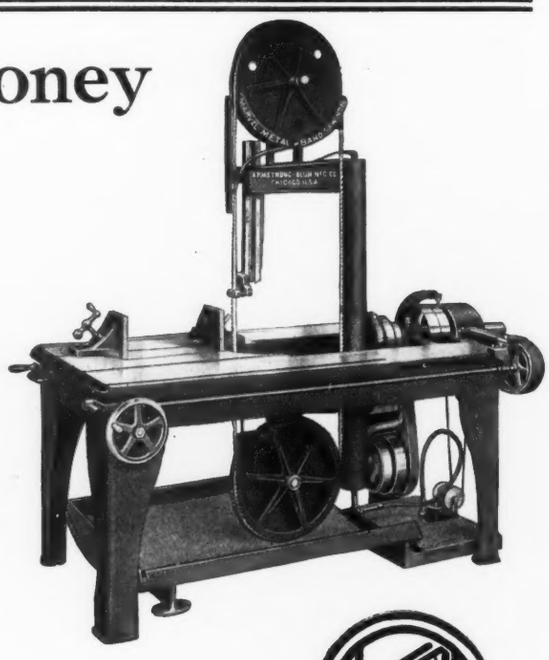
The Rhodes Rotary Table— in addition to being accurate to 2 minutes,—simplifies, and cuts production costs to a minimum. We will gladly send you details—on your request.

THE RHODES MFG. CO.
Hartford, Conn., U. S. A.



Send at once for a circular describing applications

Save time, metal, money



The Marvel Metal Band Saw No. 8—a wide range, general purpose machine for all metal sawing. The saw frame can be tilted to an angle up to 45 degrees right or left. Cuts angles or straights with equal accuracy and speed. The blade feeds through the work (held rigid in the vise)—speed and pressure can be varied to meet the needs of the operation; the big bed provides ample space for setting up large work, for holding tools, etc.

Save time, metal, money in sawing square pieces out of dies and other work—the Marvel No. 8 will perform the operation faster than a shaper and save the metal cut out.

WE WILL EXHIBIT NATIONAL STEEL & MACHINE TOOL EXPOSITION CHICAGO MUNICIPAL PIER SEPT. 20-25 BOOTH NO. 193

Capacity to 18″; send for details. See the machine in operation in Chicago.

MARVEL

ARMSTRONG-BLUM MANUFACTURING COMPANY

343 N. FRANCISCO AVENUE, CHICAGO, ILL.

SPECIALISTS

in the Manufacture of Metal Cutting

SAWS and TOOLS

"Hunter Made" SAWS PNEUMATIC HAMMER RIVET SETS and CHISEL BLANKS

are brought to a high state of perfection by a careful study of the important principles involved, namely—Design, Material, Workmanship and Heat-Treatment.

We also make Hot Saws, Friction Discs, Solid Blades made of High Speed, Vanadium Tungsten, and Chrome Alloy Steels. Saw Sharpening Machines. Inserted Tooth Grinders. High Speed Circular Metal Cut-off Sawing Machines. **Hardened Steel Specialties.** Send for Catalog.

Hunter Saw & Machine Co.

5662 Butler Street Pittsburgh, Pa., U. S. A.

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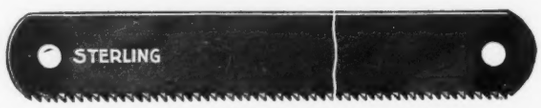

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Quality for Over Quarter of a Century

ESTABLISHED 1898

MANUFACTURED BY

Diamond Saw & Stamping Works

BUFFALO, N. Y.

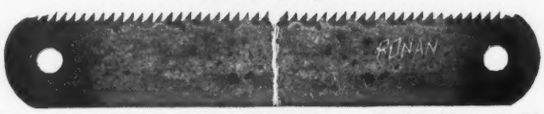
W. O. BARNES CO. INC.

DETROIT MFGS. OF MICH

METAL CUTTING SAWS

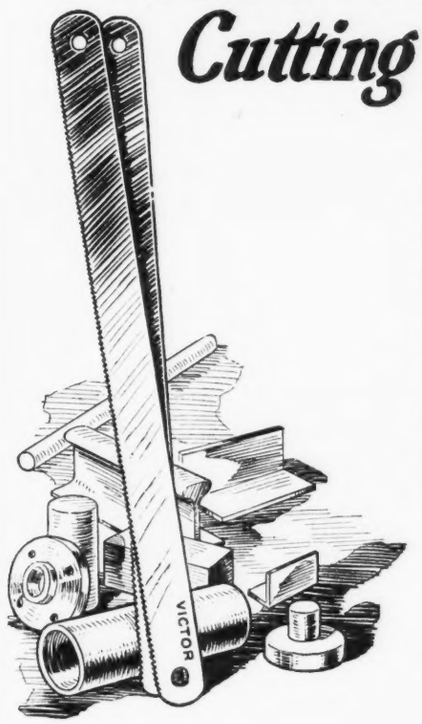
HACK AND BAND

RONAN



RONAN SAW & TOOL WORKS BUFFALO, N. Y.

Solve Your Cutting Problems!



There are no obstacles in metal cutting with Victor Blades. In shops that require hack saw cutting on all kinds of metals these blades have proven an economical and essential factor.

The Victor Special Flexible Blade has the same cutting efficiency combined with the perfected flexible qualities and is recommended for general use on all soft and tough cutting metals that produce breakage.

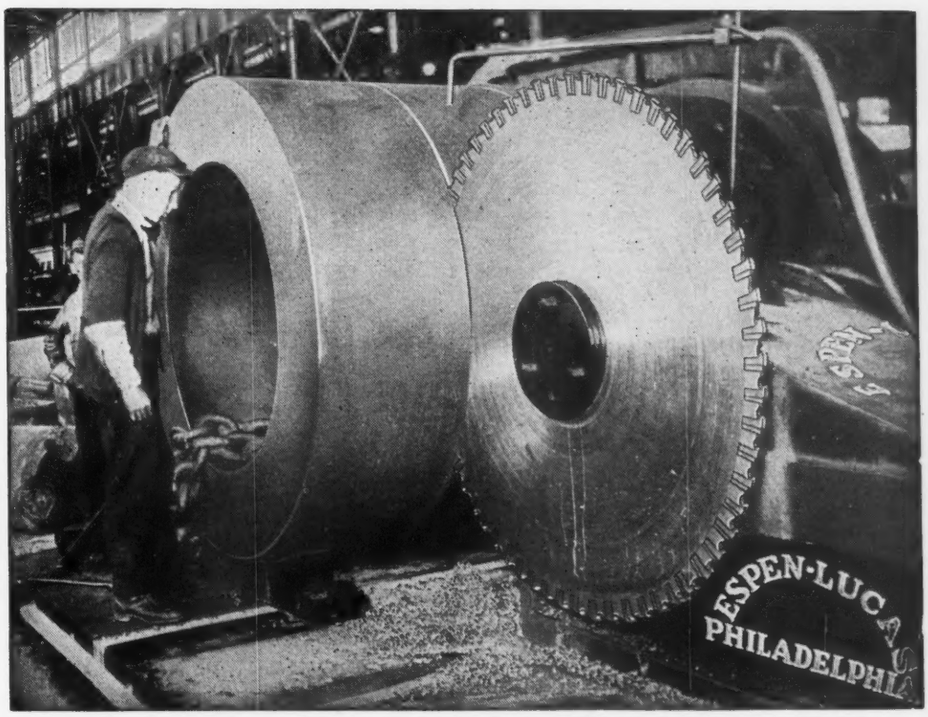
Let us send you free samples of this Wonder Blade.

VICTOR SAW WORKS
MIDDLETOWN, N. Y.

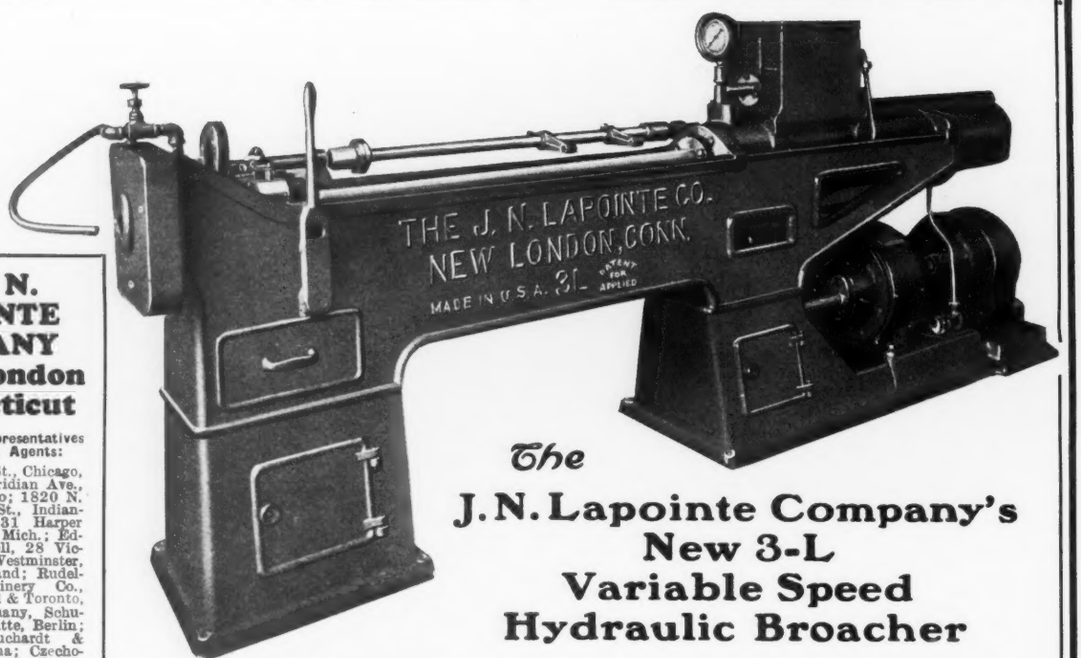
FAST AND ECONOMICAL SAWING

Tell us your needs, we have the knowledge, experience and will to correctly advise.

190 types and sizes of Sawing Machines for sawing all kinds of metal.



THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues **PHILADELPHIA, PA.**



The J. N. LAPOINTE COMPANY New London Connecticut

Domestic Representatives and Foreign Agents:

2850 Fulton St., Chicago, Ill.; 8821 Meridian Ave., Cleveland, Ohio; 1820 N. Pennsylvania St., Indianapolis, Ind.; 31 Harper Ave., Detroit, Mich.; Edward C. Farrell, 28 Victoria St., Westminster, London, England; Rudel-Belnap Machinery Co., Ltd., Montreal & Toronto, Canada; Germany, Schuchardt & Schutte, Berlin; Austria, Schuchardt & Schutte, Vienna; Czecho-Slovakia, Schuchardt & Schutte, Prague; Hungary, Schuchardt & Schutte, Budapest; Sweden, Schuchardt & Schutte, Stockholm; Denmark & Norway, Schuchardt & Schutte, Copenhagen; Jugo Slavia, Schuchardt & Schutte, Agram; France, R. S. Stokvis & Fils, Paris; Belgium, R. S. Stokvis & Fils, Brussels; Holland, R. S. Stokvis & Zonen, Rotterdam.

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J. N. Lapointe Company's New 3-L Variable Speed Hydraulic Broacher

is strongly built, powerful and adaptable to an exceptionally wide variety of operations. The stroke of the draw rod is 56" and the speed is controllable from 0 to 24' per minute on the working stroke with a constant return speed of 60 R.P.M.

A Hele-Shaw Variable Delivery Multi-Plunger hydraulic pump supplies the ram with power enough to make a 31,400 lb. pull at the draw bar possible. Speed changes can be readily made while the machine is running and can be easily controlled while in operation. In many instances production has been increased from 50% to 250% and at less overhead costs.

We manufacture High Speed Steel and Carbon Steel Broaches. Send blueprint for prices.

Of What Does This Remind You?

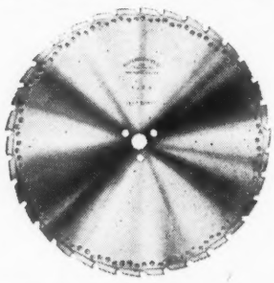
SUPPOSE that you had on hand when your first tap was broken, a commercial device built especially to remove the broken pieces of tap, a commercial device, not a home-made article, would you not have saved a great deal of time?

Write Us for Information

The Walton Company

310 PEARL STREET HARTFORD, CONN.

Lowest Cost per Cut with HUTHER SAWS



The special inserted teeth of high speed steel make Huther Saws profitable and economical. Inserts give 1¾" wear before replacing—and replacements cost but little. The saws are shaped to give proper clearance to the teeth at all times.

The Huther line covers saws for every purpose. You can try one at our expense. May we send it?

HUTHER BROS. SAW MFG. CO., Inc.

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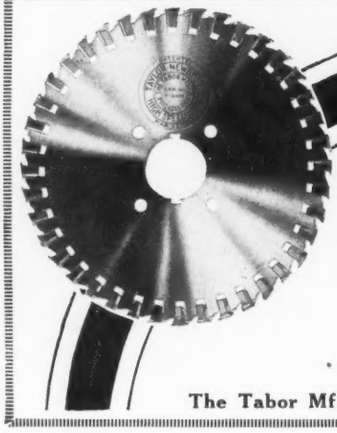

The "Specified" Saw

All users are "satisfied" users and always specify

Taylor Newbold Inserted Tooth Cold Saws

If you are cutting metal you need one

Address

The Tabor Mfg. Co., Philadelphia, Pa.

3-Cylinder Pneumatic Drills

Lightweight machines that have these advantages—

Freedom from vibration
Power and light weight
Low air consumption
Few parts—all easily accessible
Low maintenance cost

These machines are without equal for light drilling, reaming, tapping, wood boring, etc. They are made in six sizes, including non-reversible types.

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No. 6 Drill in use on passenger car work

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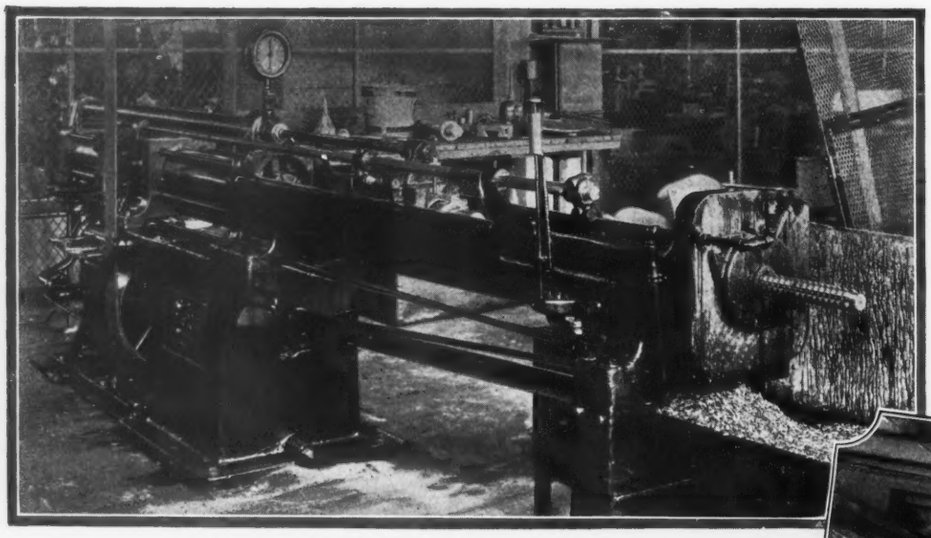
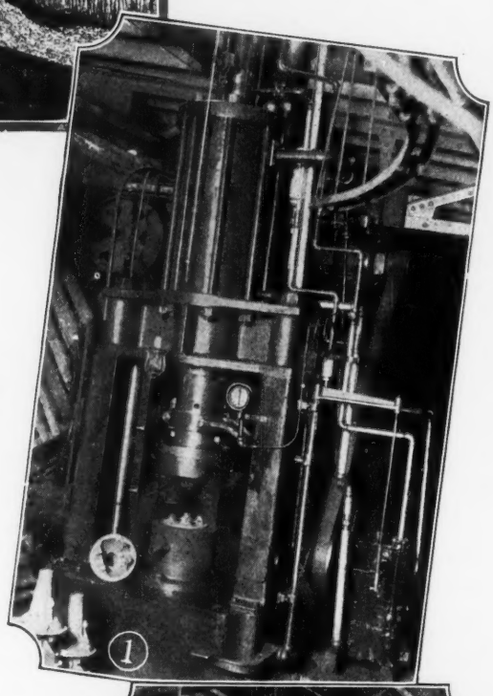


An Oilgear Broaching Machine, Broaching six spline holes

Covered by
Basic Patent
No. 1,468,595,
issued Sept. 18, 1923

1. A 100-ton Oilgear Press straightening malleable castings. Pressure remains the same even when thickness of material varies

2. 10-ton Oilgear Press Broaching connecting rods



Precision Accuracy on Production Basis with OILGEAR

It's when working to close limits that an Oilgear machine shows best its inherent superior qualities. There is no shock or jar at the beginning of the cut and the smooth, vibrationless action eliminates the tool marks common to other type machines. This feature in many cases makes the usual light finishing cut unnecessary.

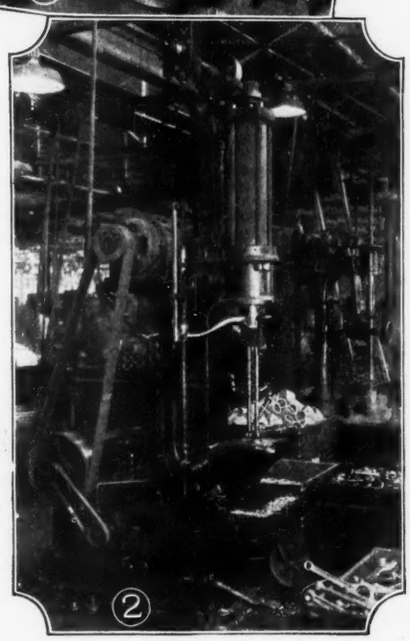
Because the pull on an Oilgear machine is always at right angles to the cross-head there is no torsional strain to throw the tool out of true or cause excessive wear on the ways.

When doing a pressing job the ram is brought against the work and the pressure started from there—no impact to cause breakage or set up undue strains in the material.

Of course, such performance is possible only with a hydraulic machine—but Oilgear is different. No pressure lines or accumulators to be maintained, each Oilgear is a complete unit in itself. Simply attach to any constant speed source of power and it's ready for accurate, speedy production.

There are many features of Oilgear that will appeal to your shopman's appreciation of a fine tool. Write for the Oilgear Bulletins.

THE OILGEAR COMPANY
660 Park Street, Milwaukee, Wisconsin



OILGEAR

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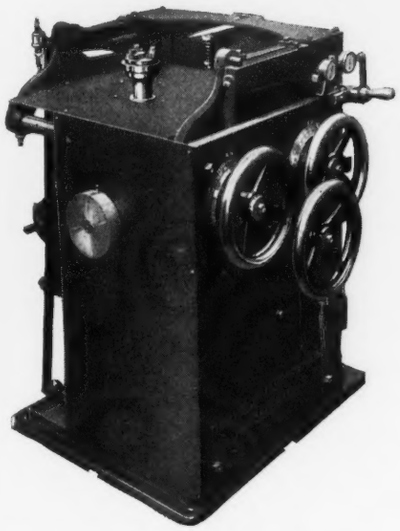
Oilgear Hydraulic Equipment

PRESSES — BROACHING MACHINES — TRANSMISSIONS — PUMPS

OLSEN

Balancing Machines



Olsen-Lundgren Flywheel Balancing Machine. A vertical spindle machine which rapidly determines static and dynamic unbalance in flywheels, clutch parts, separator bowls, etc.

Greater Efficiency and Longer Life from Your Machines—

Perfect balance of the rotating parts is an absolute essential to the successful operation of much high speed machinery, and adds to the efficiency and long service life of any machine through increased power, elimination of vibration, and greatly lessened wear and tear.

The determination of unbalance has been made a routine procedure by many automotive manufacturers and builders of machinery. It is a comparatively simple matter with Olsen Balancing Machines.

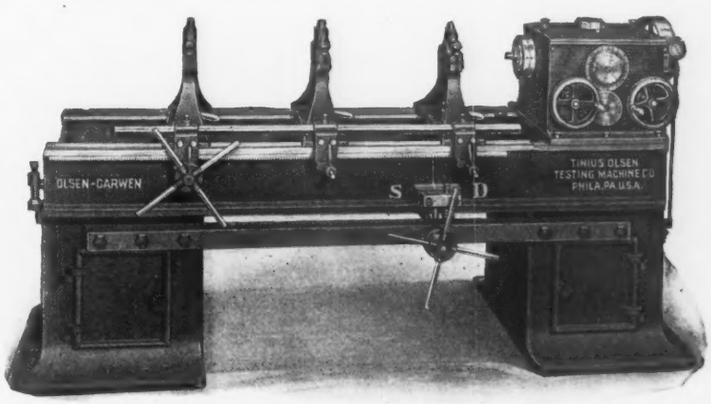
Olsen Balancing Machines accurately determine both static and dynamic unbalance, independently. It is unnecessary to stop the machine or reverse the part. Values are read in ounce-inches directly from indicating dials, and the angle or plane of unbalance and axial location are shown. It is sometimes only necessary to add or remove metal at one point to make complete correction for both static and dynamic unbalance.

The operation of Olsen Balancing Machines is positive and accurate, and so simple and rapid that balancing can be done on a satisfactory production basis.

Perfect balance in your machines is an assurance of their continued perfect performance.

This booklet discusses the theory of unbalance in a thoroughly practical way, and describes its rapid correction with Olsen Balancing Machine.

Copy sent on request.



Olsen-Carwen Static-Dynamic Balancing Machine for determining unbalance in shafting, rotors, and rotating assemblies, and completely assembled machines. Types available to handle parts from 4 pounds to 75 tons.

TINIUS OLSEN TESTING MACHINE COMPANY, Philadelphia, Pa.
500 North Twelfth Street

See our exhibit at The Sesquicentennial International Exposition, Philadelphia, Pa.

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NATIONAL STEEL & MACHINE TOOL EXPOSITION
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BOOTH NO. 197

Get this New Book!

A new edition of the X-L-O Spindle Book "Grinding" is just off the press. It contains the story of some spectacular grinding achievements, and a concise understandable description of the spindle which has made them possible. The book will be mailed free to executives. Ask for yours today!

Ex-Cell-O
Tool & Mfg. Co.

XLO

1467 E. Grand Blvd.
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About this grinding operation: Everything narrows down about the spindle, doesn't it?

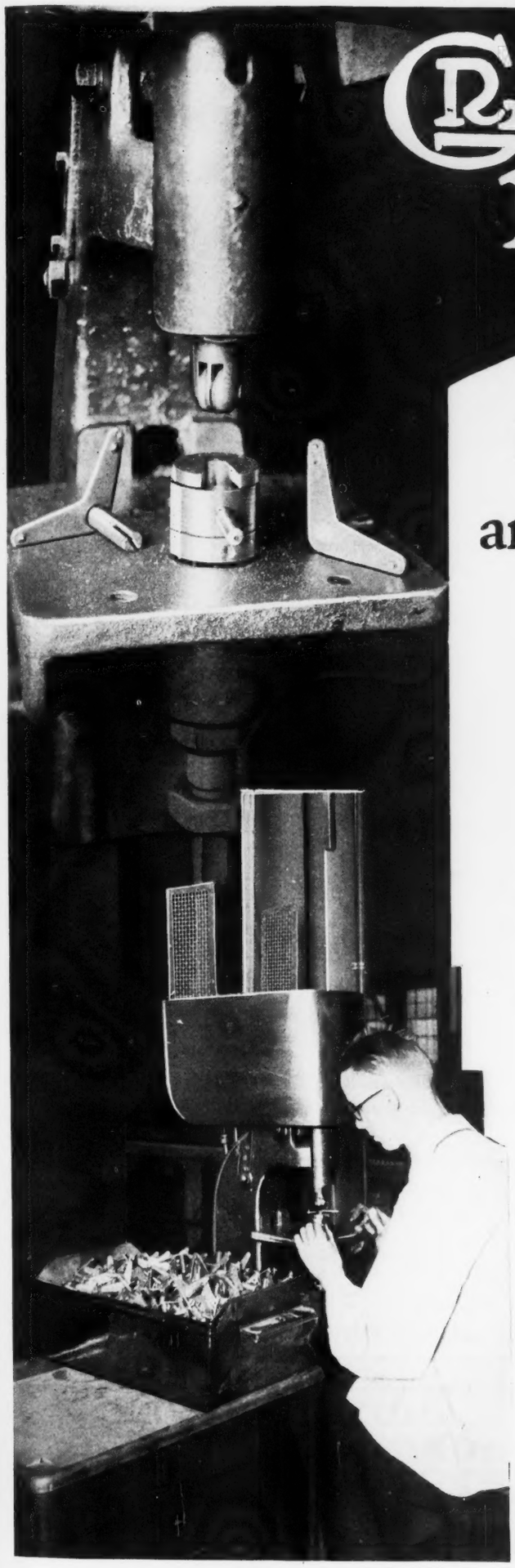
The cutting edge is the most important part of a knife. And the spindle is the most important part of the grinder!

"High speed and accuracy"—that's the demand of present-day production schedules. No other spindle, we sincerely believe, has been developed to equal this XLO product in speed, accuracy and long life. . . Principally the XLO ball bearing, specially designed, far and away in advance of the ordinary commercial ball bearing for this particular purpose.

The grinder is the big investment—not the spindle. Yet upon the efficiency of the spindle rests the efficiency of the grinder! Comparatively, your investment in an XLO spindle is insignificant.

Why not find out the facts about the XLO spindle? There's a new descriptive booklet. We want to send one to you!

X-L-O *Internal Grinder* SPINDLES



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Four Times Faster and More Satisfactory

Grant Riveting cold rolled steel pins 7/16″ in diameter at the rate of 200 per hour, each pin tight and well set, each head uniform in size and finish. The best time by previous methods was 50 per hour—and at that there was trouble because the shoulders frequently sheared off in the operation.

The small studs in the same piece are also Grant Riveted with an appreciable saving of time and material.

Grant Rivet Spinners, Grant Vibratory Riveters—noiseless, easily operated, *fast and accurate* are making savings as good or better than this on all classes of work in all kinds of plants.

May we quote results on work like yours?

The Grant Mfg. & Machine Company

N. W. Station **Bridgeport, Conn.**

Efficient Grinding Equipment

That Lowers Grinding Costs

Grand Rapids Universal Cutter and Tool Grinders are thoroughly practical, efficient, and accurate equipment built for easy operation and high production. Unusually flexible adjustment gives maximum convenience and efficiency for each operation. Grand Rapids Universal Grinders afford greatest output at the lowest cost.

Grand Rapids Grinders do not become obsolete with a change in design.

Grand Rapids Universal Grinders
Are Built in Four Styles and Sizes

No. 1 Hand Feed, Dry Machine which swings work 9½ x 20 inches. Weight 525 lbs.

No. 2 Hand Feed, Dry Machine, similar to No. 1, but with Drill Grinding Feature.

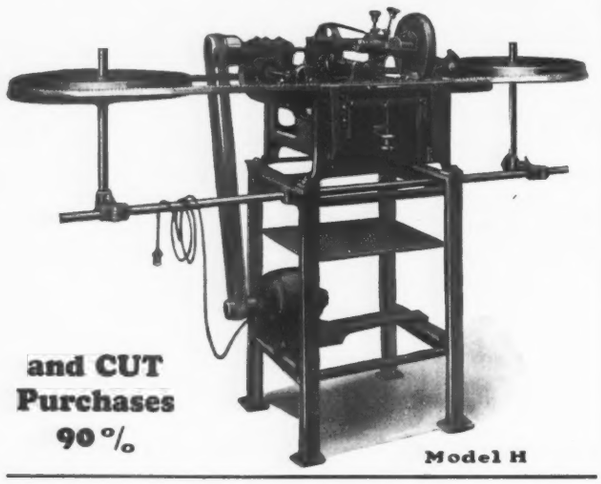
No. 3 Hand Feed or Power Feed, Wet or Dry, swings work 10½ x 26 inches. Weight 1500 lbs.

No. 4 Hand Feed or Power Feed, Wet or Dry, swings work 10½ x 32 inches. Weight 1600 lbs.

Send for Complete Data

GALLMEYER & LIVINGSTON CO.
344 Straight Ave., S. W. Grand Rapids, Mich.

STOP
Throwing Away
METAL CUTTING
Hacks & Bands



and CUT Purchases 90%

Model H

You can salvage a band saw for 5c. A hack for 2c.

THE WARDWELL MFG. CO.
Makers of automatic machines for sharpening—Hack Saws, Hard Tempered Band Saws, Milling, Slitting and Screw Slotting Saws and all Woodworking Saws.
Manufacturers of the largest line of Saw Filers made in U. S. A.
111 Hamilton Ave., CLEVELAND, OHIO

Winterhoff No. 2 Portable Grinder
A Highly Profitable Installation

The No. 2 Portable Grinder is ideally suited to smoothing die blocks, bearing caps and parts that require a smooth, straight surface. On one end of the motor spindle a 6" by ½" tool grinding wheel revolves;—on the other end are an 8" disc grinder, a tilted table with a milled groove and a protractor guide. This arrangement facilitates grinding on squares, angles and mitres.

Price $45

Send for details

WINTERHOFF TOOL & MACHINE CO.
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Broach Instead of Machining

Many drilling and machining jobs can be done more cheaply and rapidly by broaching with Lapointe Broaching Machines and Broaches. Our engineers will gladly help you select the most profitable method.

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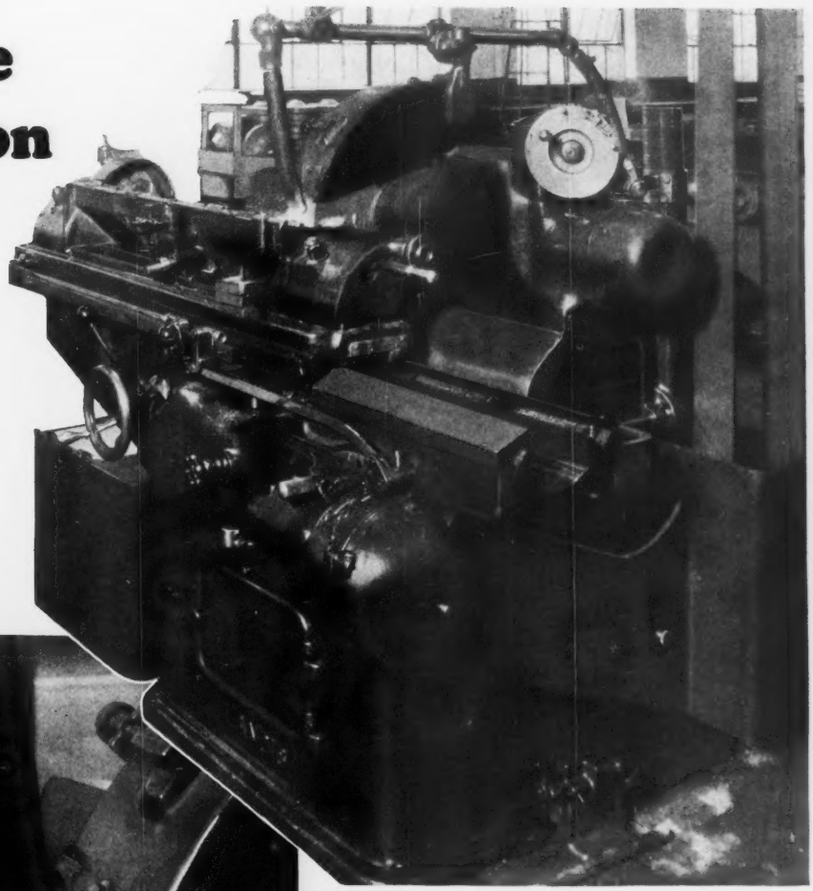
MOTOR DRIVEN GRINDING, BUFFING, POLISHING STANDS

Cleveland Armature Works, Inc.
4782 St. Claire Ave. Cleveland, O.

20% Increase in Production and More Than 50% Saving



LANDIS

As soon as this 6 inch Landis Hydraulic Grinder was installed *production jumped 20%*. It is being used to grind the bearings on automobile cam shafts, and three bearings are ground before work is removed from the machine.

Not only was production increased, but a saving of *more than 50%* was made on wheel cost and a still greater saving on diamond cost.

In no case has one of these machines failed to give gratifying increases in production and reduction of costs. Let us tell you what it will do on your work.

LANDIS TOOL CO., Waynesboro, Pa.

New York Office: 30 Church St. **Chicago Office: 618 W. Washington Boulevard.** **Detroit Office: 5928 Second Boulevard.**

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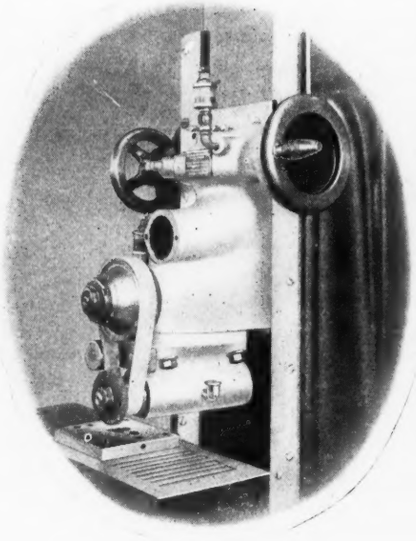
ABRASIVE

High Speed Attachment for No. 3 Surface Grinder

A great convenience in the Tool Room for Gauge and Jig work especially.

Applicable to all No. 3 ABRASIVE machines upon the market.

Write About It



Abrasive Machine Tool Co.

East Providence, R. I.

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

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Builders of
Hole Grinders
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Deep Hole Grinders

STOW Portable Grinder

All sizes, all currents.

For Abrasive wheel, wire scratch brush, and similar applications.

Indispensable for grinding and similar work, built only by the

STOW MANUFACTURING CO., Inc., Binghamton, N. Y.
London Stock: 26 Charles Street

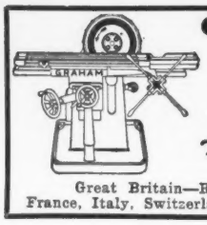
Porter-Cable Belt Grinder also sands & polishes.
Motor Driven. Two Sizes. Write us
Porter-Cable Machine Co. Syracuse, N. Y

Emery Wheel Dressers

Two Sizes **CUTTERS** Nos. 1-2

We make the regular Huntington (Pattern) for all sizes.
Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER CO., Lancaster, Pa., U. S. A.



GRAHAM GRINDERS

KNEE TYPE—RING WHEEL
for Flat Surfaces
PULLEY GRINDERS
GRINDER CHUCKS
for all machines, 10" to 30".

THE GRAHAM MFG. CO.
Providence, R. I.

Great Britain—Richard Lloyd & Co., Ltd., Birmingham.
France, Italy, Switzerland, Spain and Holland—Fenwick Freres & Co.

Putting Gear Tooth Grinding on a *"Production Basis"*

PROFIT production is the purpose of the WALCOTT Gear Tooth Grinder. Its capacity for producing accurately ground high grade gears rapidly and efficiently makes it an indispensable money saving unit in high grade plant production.

Materials and workmanship throughout are the best obtainable. All bearings are of the best bronze; and steels have been selected for great strength and long life. In other words, the Walcott Gear Tooth Grinder will soon pay for itself with the original investment still intact.

The power-driven index mechanism is accurate and rapid, requiring less than a second to index. Two machines may be operated as a pair. One operator easily handles both machines.

WALCOTT MACHINE CO.
(Formerly Walcott Lathe Co.)
Factory and Main Office: Jackson, Michigan
Detroit Office: 3-128 General Motors Building

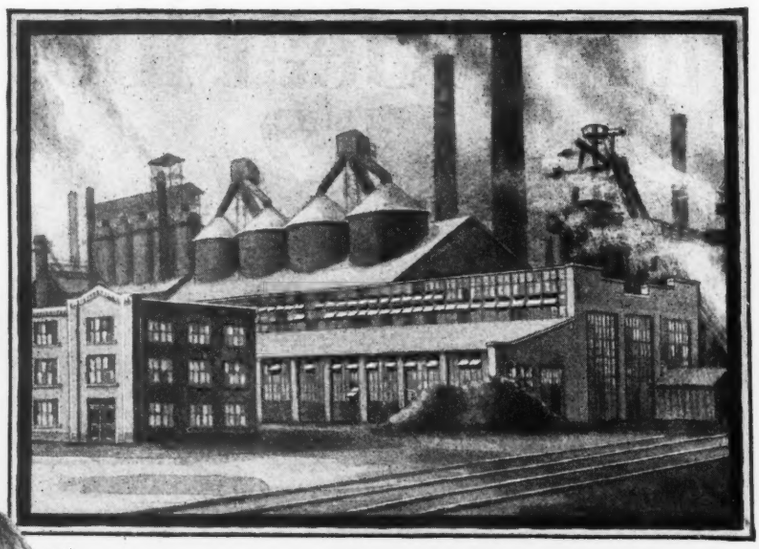
Manufacturers of Gear Grinders, Cam Lathes, Crankshaft Contour Lathes and Gear Burring Machines

Photographs, estimated production and detailed description furnished on request.

Left side of Walcott Gear Tooth Grinder showing high speed cutting wheel in right hand position. The machine is very thoroughly guarded.

Precision Machines for the Automotive Industry

walcott



Yesterday's ideas are as old as a last Year's Bird's Nest

Development in all fields of production is swift, sudden; changes for the better occur every day. Your grinding wheels may have produced good results last year—but how about this year?

Improved processes have been developed. Sterling Grinding Wheels are producing more and better grinding, producing results that render yesterday's ideas of grinding as old as a last year's bird's nest.

Bring your grinding up-to-date. Bring your grinding costs down to today's level. It means lowered selling resistance and increased profit opportunities.

Call in a Sterling Grinding Engineer and let him tell you some brass tack facts about today's grinding results.

THE STERLING GRINDING WHEEL COMPANY

Abrasive Division of The Cleveland Stone Co.

Factory and Office, Tiffin, Ohio. Branch at 23 S. Jefferson St., Chicago.

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TIFFIN OHIO

The Symbol of Better Grinding

Grinding Wheel Distributors

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ST. PAUL, MINN.—Adam Decker Hardware Co.

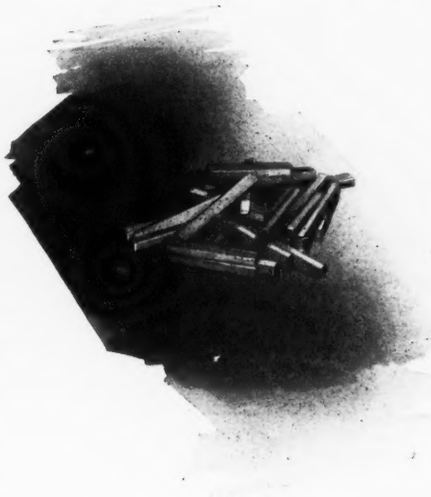
WATERTOWN, N. Y.—W. W. Conde Hardware Co.

YOUNGSTOWN, O.—The Stambaugh-Thompson Co.

STERLING ABRASIVES

AND STERLING GRINDING MACHINES

SAVING SIXTY PER CENT ON THIS CUT-OFF JOB



Glad to put a Trial Wheel in Your Plant

IN the plant of the Atwater Kent Company at Philadelphia they had a real problem in cutting off 7/8 x 3/8 inch magnet steel bar stock.

It was costing them $10 a thousand to cut the bar into small lengths using a competing wheel.

The stands were equipped with Aloxite Redmanol Cut-off Wheels and the production costs dropped with a rush.

They are now cutting the stock at a cost of $4 per thousand or a saving of sixty per cent.

And the Aloxite Redmanol Wheels show far longer life, doing from 1,800 to 2,000 cuts on this extremely tough material and doing it at the rate of five cuts or pieces a minute.

Aloxite Redmanol Cut-off Wheels cut fast and with an amazingly free action. They will not bind or stall even under heavy feed. They fairly walk through the stock.

They can be used for cutting small stock of steels, stellite, brass, bronze, aluminum, glass, vitrolite, carbon, bakelite or porcelain.

Aloxite Redmanol Cut Off Wheels

SAVE TIME—SAVE STOCK—SAVE LABOR

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

CANADIAN CARBORUNDUM COMPANY, LTD., NIAGARA FALLS, ONT.

New York Chicago Boston Philadelphia Cleveland Detroit Cincinnati Pittsburgh Milwaukee Grand Rapids

On a "BLOUNT"

You Can Always See the Point

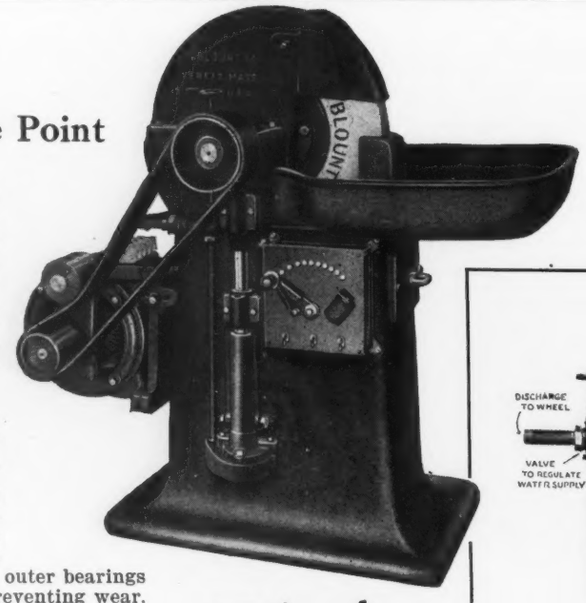
when grinding your tools. Valve regulation on the centrifugal pump makes possible an even, steady spray of water at the point of grinding, sufficient for effective cooling without obscuring a clear view of progress of tool grinding. Quickly and easily adjusted, tools can be rapidly and accurately ground without burning on a BLOUNT WET TOOL GRINDER, and with a saving of the operator's time, temper and patience.

When not in use the valve is closed, the wheel runs dry, and the danger of water absorption is avoided. Safety is assured.

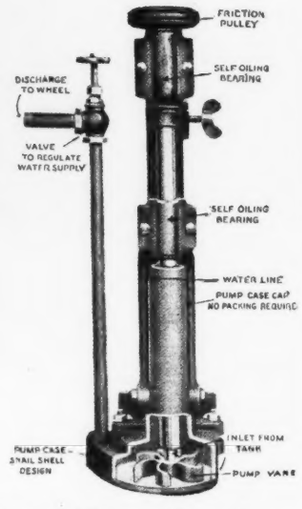
The pump design is the simplest. Belts are eliminated by the positive, adjustable friction drive. No pump packings are necessary. The "full floating" centrifugal propellor supported by self-oiling outer bearings is free from the case at all points, thus preventing wear.

Heavy construction throughout the machine insures rigidity, freedom from vibration and long life.

Uninterrupted production is maintained, when BLOUNT WET TOOL GRINDERS are used to keep tools in shape. Insist on a "BLOUNT."



Send for our latest Catalog No. 22



Sectional View of Pump for use on Blount Wet Tool Grinders

"Blount"
J. G. BLOUNT CO. U.S.A.

Products
Grinders
Lathes
Polishing Machinery
(Belt and Motor Driven)

J. G. BLOUNT COMPANY

Machine Tool Builders

EVERETT, MASS., U. S. A.

A Versatile Grinder

BATH *Universal*

Grinding Machine

THE Bath No. 2 Grinder embodies many distinctive and desirable features essential for rapid and accurate production of commercial and tool room grinding.

This machine is adapted for the grinding of cylindrical, internal, surface, disc, cutter and reamer work of all kinds.

As an investment in any machine shop it cannot be beaten.

Drop a post card for catalog

UNIVERSAL Grinding Machine

Universal Grinding Machine Co.

Fitchburg, Mass.

LA SALLE No. 2
Automatic Surface Grinder

furnished with Countershaft, vise with hardened jaws, wheel trueing device and wrenches. For dry grinding only.

Price $550.00 Net F.O.B. La Salle, Illinois.

This grinder is indispensable for grinding flat surfaces, parallels and gauges, dies, punches, cutters—straight, fluted-hobs and any number of manufacturing jobs.

Also furnished as follows:

Wet Attachment $70.00 extra. Motor Drive including 1½ HP DC or AC Motor complete $215.00, or arranged for motor drive exclusive of motor, $100.00 additional. All prices Net F.O.B. La Salle, Illinois.

Capacity 20"x 6"x10"

Send for descriptive matter

La Salle Tool Co.

La Salle, Illinois

Also manufacturers of La Salle No. 1 Plain and Surface Grinder $115.00. LaSalle No. 3 Plain and Surface Grinder $365 to $390 and American Twist Drill Grinders $120 to $350 F.O.B. La Salle, Illinois.

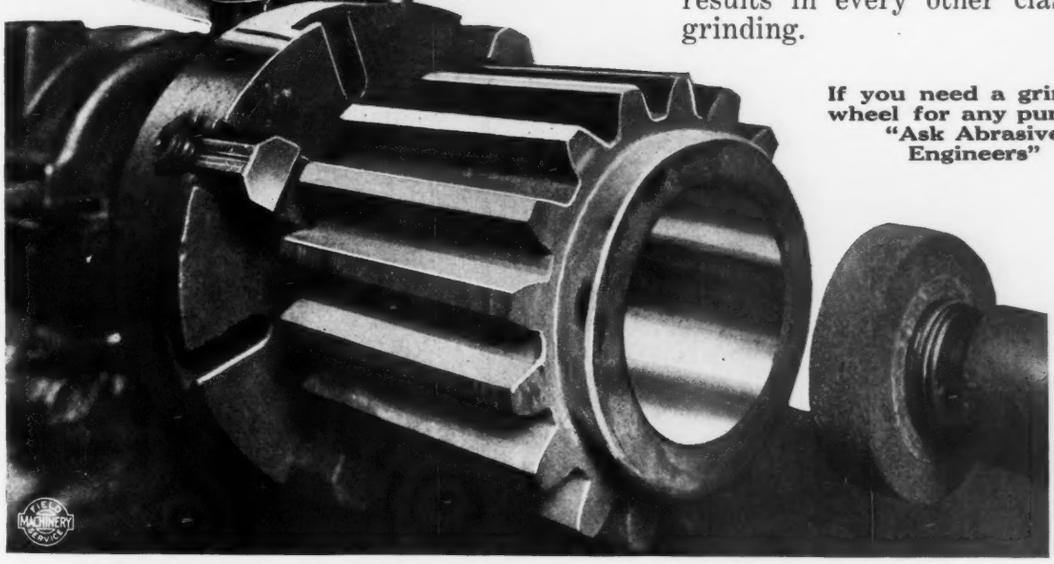
GRINDING GEARS—

Where Accuracy Counts

Manufacturers of high grade gears watch every step in their production. For this reason they do their grinding with "Abrasive" Wheels. "Abrasive" quality insures perfect finish; and accuracy is obtained without wasting time in wheel adjustments.

This forged steel, heat treated gear measures 8″ across the face, 9″ diameter, 10″ long. The base is ground to 5″ diameter + .001″, about .020″ of stock is removed in 25 minutes, about forty bores this size are ground before the wheel is put aside for smaller work.

"Abrasive" grinding wheels—clean cutting, fast, long wearing—produce equally satisfactory results in every other class of grinding.



If you need a grinding wheel for any purpose, "Ask Abrasive Engineers"

ABRASIVE COMPANY

Main Office and Factory: BRIDESBURG, PHILADELPHIA, PA.

Factory Branch—566 W. Washington Boulevard, Chicago; District Office—149-65 Larned Street, East, Detroit, Mich.

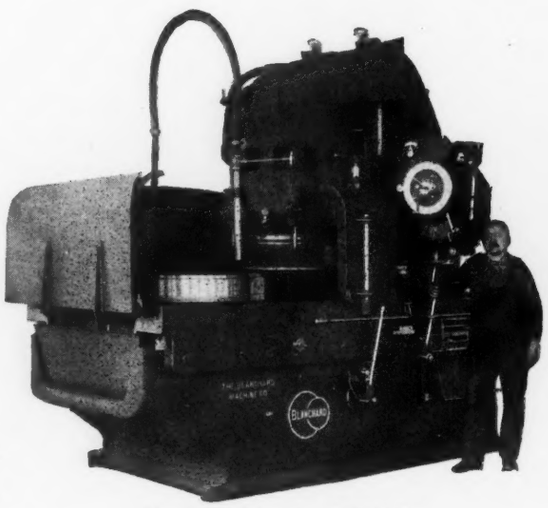
Borolon— TRADE MARK — TRADE ABRASIVE MARK REGISTERED — **Electrolon** TRADE MARK

BLANCHARD GRINDING

covers a wide range of work. This largest Blanchard Surface Grinder swings work up to 7 feet diameter. It extends the advantages of Blanchard Grinding to your larger work. Its users are all enthusiastic over the savings it makes.

Whether your work is large or small you should at least investigate the Blanchard. Samples and blueprints will receive prompt attention.

See the improved No. 16 Blanchard Grinder in operation, National Steel & Machine Tool Exposition, Chicago, Sept. 20-24.



No. 27-R Blanchard Grinder

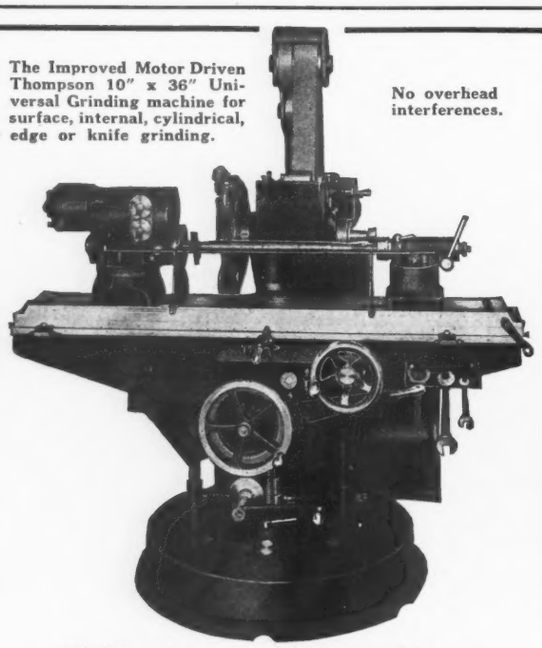
THE BLANCHARD MACHINE COMPANY

64 State Street, CAMBRIDGE, MASS.

Dealers: UNITED STATES—Henry Prentiss & Co., Inc.; Motch & Merryweather Machinery Co.; Marshall & Huschart Machinery Co.; W. E. Shipley Machinery Co.; Kemp Machinery Co.; Marshall & Huschart Machinery Co. of Indiana; Elliott & Stephens Machinery Co.; Robinson, Cary & Sands Co.; Harron, Rickard & McCone; The Hendrie & Bolthoff Mfg. & Supply Co.; Huey & Philip Hardware Co.; Woodward Wight & Co., Ltd. CANADA—Williams & Wilson, Ltd.; F. F. Barber Machinery Co. GREAT BRITAIN—Burton, Griffiths Co. FRANCE—Aux Forges de Vulcain. ITALY, SWITZERLAND, BELGIUM, SPAIN and PORTUGAL—Allied Machinery Co. of America. SWEDEN—A. B. Rylander & Asplund. JAPAN—Andrews & George Co. CZECHOSLOVAKIA—Ing. M. Kocian & G. Nedela. GERMANY—Schuchardt & Schutte A. G. SOUTH AFRICA—D. Drury & Co., Ltd.

The Improved Motor Driven Thompson 10" x 36" Universal Grinding machine for surface, internal, cylindrical, edge or knife grinding.

No overhead interferences.



Efficient Grinding

The Thompson Grinder is universal in scope and universally satisfactory because it performs every type of grinding service with the convenience and efficiency of a machine designed for one operation alone. Complete, efficient service at one first cost, one operating cost, and with a minimum of floor space—that's what Thompson Grinders give, and it's a highly profitable combination.

Let us send further information.

The Thompson Grinder Co.

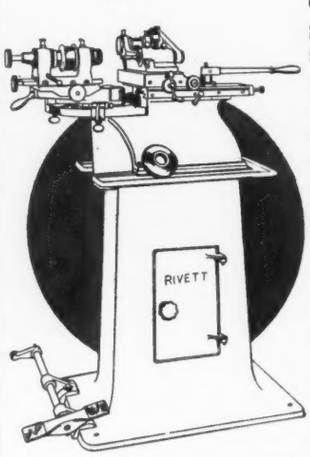
Springfield, Ohio, U. S. A.

Grind Your Spherical Work-

on a grinder that generates a true spherical surface without depending on a formed wheel, and that is equipped with rapid chucking devices and dial gauge attachments for size control.

This can all be done on a properly equipped

Rivett



No. 205 Radial Grinder

Send us your blueprint and we will tell you how we would tool up if the job was ours

Rivett Lathe and Grinder Corporation

Brighton District, Boston, Mass.

Automatic Buffing Machines

Doubled the Work—
Improved the Quality

The contract manufacturer in whose plant these Automatic Buffing Machines were photographed, installed them primarily to insure absolutely uniform finish on highly polished aluminum hub caps for automobiles.

He got the desired uniformity—rejects were practically eliminated—and *doubled production on the parts as well!*

Automatic Buffing Machines improve polishing methods, reduce costs to an extent that frequently enables an installation to pay for itself in three months.

Made with single or multiple spindles, equipped with special work holding fixtures, they handle a remarkably wide range of work. Samples, blueprints, drawings of work will enable our engineers to tell you whether a profit making Automatic Buffing Installation can be applied to your work.

AUTOMATIC BUFFING MACHINE COMPANY

Chicago and Perry Sts., BUFFALO, NEW YORK

Let us submit production estimate based on your samples or blue prints. Our interesting booklet

"Hidden Profits"

describes machines and the work they do.

Low Cost Polishing

Here's a random instance of work turned out with a "Production" Polishing Machine:—

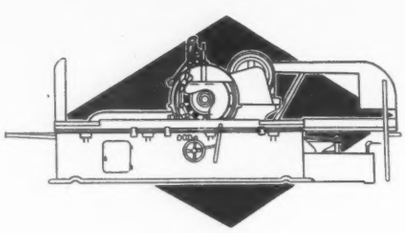
> Hard fibre tubes 2″ in diameter and 4″ long are given a fine black gloss polish in two passes, each pass taking but *two seconds.*

That is only one of the thousands of low cost polishing records sent us by enthusiastic users—"Production" Machines take work up to 4″ in diameter, and require no centering or chucking. Production is continuous and uniform, with spoilage practically unknown. The finish is better than much hand buffed work, and no skill is required. Operating and upkeep costs are low.

PRODUCTION MACHINE CO.

GREENFIELD, MASSACHUSETTS, U. S. A.

Motch & Merryweather Machinery Co., Cleveland, Detroit, Pittsburgh, Cincinnati. F. C. Hermann, 558-560 W. Washington Blvd., Chicago, Ill.



All We Ask Is the Opportunity to Prove that *Face Grinding*

is a cheaper and better method of producing some flat surfaces.

If you don't believe it, write us and we will prove it to you just as we have to some of the largest and best known mechanical authorities in this country.

Do you want the evidence?

DIAMOND MACHINE COMPANY

(Grinding Machine Specialists)

Providence, R. I.

DIAMO-CARBO GRINDING WHEEL DRESSER

A Tool Room Necessity

Send for the catalog of Desmond-Stephan wheel dressing tools, Huntington, in three sizes, Sherman, magazine, etc., standard and special tools. Diamonds in stock for selection.

The Desmond - Stephan Mfg. Company

URBANA, OHIO

New England Representative, George L. Gaylord, Westfield, Mass. The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont. Alfred Herbert, Ltd., Coventry, England, Agent for Great Britain.

THE RIGHT TOOLS

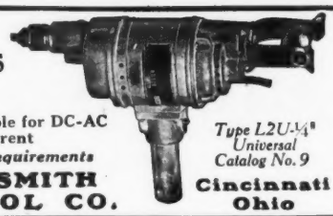
Francis Diamond Tools contain genuine diamonds and are the right tools for getting the most grinding life out of any abrasive wheel. Available for every standard make of grinder. Send for price list.

FRANCIS & COMPANY

First Nat'l Bank Bldg. 50 State St., Hartford, Conn.

Est. in 1799 Keep Your Wheels Right for Good Grinding

PORTABLE ELECTRIC DRILLS and GRINDERS



Complete line of sizes suitable for DC-AC and Universal Current

Tested to U. S. Navy requirements

Type L2U-¼" Universal Catalog No. 9

THE NEIL & SMITH ELECTRIC TOOL CO.

Cincinnati Ohio

This IS Economy!

THE Grinder No. 24 Continuous-feed Disc Grinder is shown grinding intake manifolds for the Hupmobile '8' in the new plant of the Hupp Motor Car Corp., Detroit, Mich.

There are two operations on each piece, as the photograph shows, and the manifolds are finished to a size, and held square.

60 pieces per hour, COMPLETE, tells the story of the economy of CONTINUOUS DISC GRINDING -- a story which is daily being duplicated by such companies as Toledo Scale Co., Toledo, O., Horton Mfg. Co., Ft. Wayne, Ind., Foote-Burt Co., Cleveland, O., and others of equal rank.

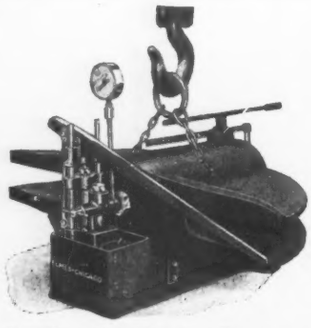
There's a SEMI-AUTOMATIC or a HAND-OPERATED Gardner Grinder to effect greater economies upon YOUR flat surfaces.

60 intake manifolds ground per hour, COMPLETE (2 faces finished.)

JUST TO START THINGS, WRITE FOR OUR No. 24 BULLETIN!

GARDNER MACHINE COMPANY

414 EAST GARDNER STREET BELOIT, WISCONSIN, U. S. A.



HYDRAULIC PRESSES PUMPS CHICAGO

ELMES

SINCE 1851

Do Your Forcing Work Where Most Convenient

OUT OF THE WAY WHEN IDLE

NOT IN THE WAY WHEN BUSY

Our Portable Forcing Presses, arranged for Handling by Crane, are very often more desirable than the Horizontal Wheel Press. They are built in various capacities up to 400 tons and mounted with Hand-Operated or Power-Driven Pumps as preferred. *Minimum Investment—Maximum Service.*

CHARLES F. ELMES ENGINEERING WKS., 222 N. Morgan St., Chicago, U. S. A.

Radically Different

THE "GEIER"

Double independent spindle electrically driven

Polishing and Buffing Lathe

Positively reduces costs. Features—variety of speeds; full ball bearing; dust-proof; automatic brakes; sturdy design; practically noiseless; 3 sizes—5, 7½ and 10 horsepower.

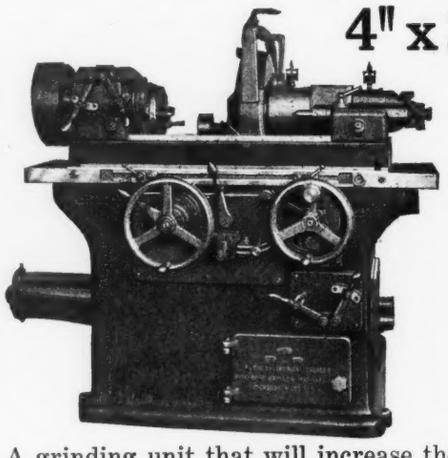
Send for Circular and Price Lists

Manufactured by

THE P. A. GEIER CO.

CLEVELAND, OHIO

Replace the cumbersome unit with a Fitchburg 4" x 20"



A grinding unit that will increase the profit of your shop—will do work now being done on machines of much larger size—which cut into the profits of your work.

This Model A, Automatic Feed, embodies rigidity, accuracy, low cost of production, ease of control. It occupies floor space of only 49-in. x 80-in.

Manufacturers of Model A, Automatic Feed; Model B, Hand-operated Grinding Machines.

Circulars on request.

Fitchburg Grinding Machine Co.

Fitchburg, Mass.

Increased Confidence—Increased Production

The Wiesman Safety Punch Press Guard sweeps the full length of the bolster plate at every stroke—entirely automatic, no button or lever to press.

The Wiesman Guard does not interfere with operation, entirely out of the way for fast feeding.

The operator works faster because free from fear of accidents, and increased production means more profit. No adjustments to make—quickly attached.

Illustrated circular gives full description of the guard. May we send it?

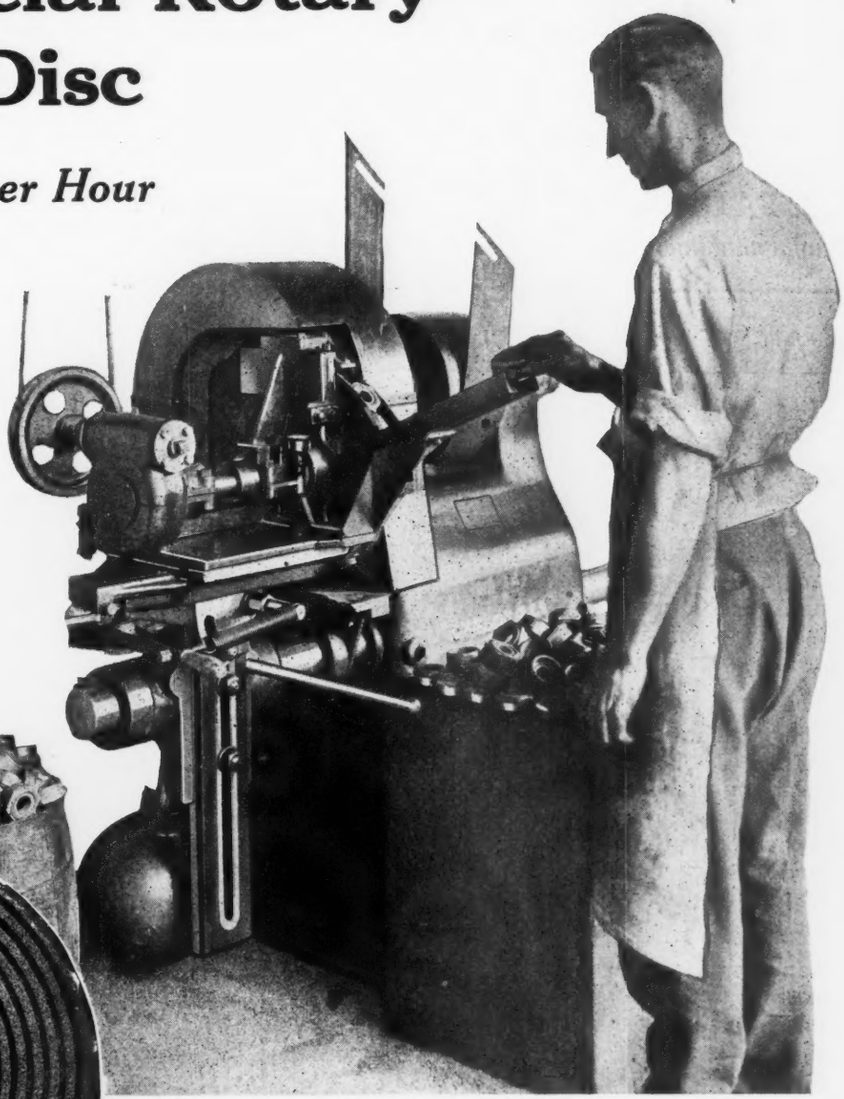
Wiesman Manufacturing Company

31 to 35 South St. Clair Street, DAYTON, OHIO

A Besly Grinder with Special Rotary Feeding Disc

Production 3,000 per Hour

Here is a good example of the production that can be secured with Besly equipment. The operation is grinding off the gate from hexagonal castings. We are not permitted to mention the name; but the concern is one of the prominent manufacturers of steam fittings.



The Besly-Titan Spiral Abrasive Disc
(Patent Applied for)

The use of Besly-Titan Abrasive Discs (heavy cement bond discs, made entirely of abrasive grain with minimum amount of bond), set up with Redisc Cement is a radically new development in the art of disc grinding. No more stopping the machine every few hours to replace abrasive discs. No more waiting days for liquid cements to dry out. Write today for new booklet.

The work was formerly done free hand, grinding on the periphery of an ordinary emery wheel. Now a No. 14 Besly Grinder, equipped with a Special Rotary Feeding Device, is used. All the operator does is to drop the castings into the chute, with the gate in the proper position, and the machine does the rest.

Not only does the Besly method produce a better class of work; but *production has been jumped to* 3,000 *pieces per hour.*

Perhaps we can help improve quality or jump production, or both, on some of your work. It will cost nothing to find out—just write us.

Charles H. Besly & Company
120-B No. Clinton St., CHICAGO, ILL., U. S. A.

Hydraulic and Hydro-Pneumatic

Straightening Presses

In Capacities of from 10 Tons to 200 Tons

METALWOOD MFG. CO. 3358-3366 Wight Street DETROIT—MICH.

ATLAS PRESSES

Give More Than Rated Pressure

Atlas Arbor Presses are exceptionally satisfactory for short broaching jobs, driving arbors, fitting pulleys, straightening, punching, and similar work for which an arbor press is indispensable.

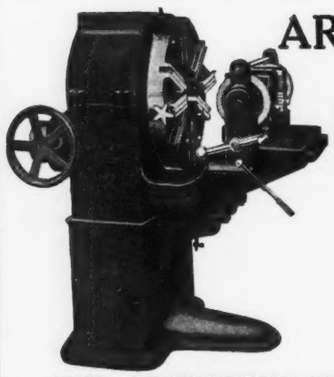
Atlas Arbor Press No. 3

They are well and strongly built, and develop much more pressure than their rated capacity. Patented Leverage Device enables operator to work continuously without tiring.

Hand and power type presses to deliver pressures up to 50 tons.

Circular on request

ATLAS PRESS COMPANY
KALAMAZOO, MICH., U. S. A.



ARMSTRONG No. 3 Pipe Threading Machine

POWER ONLY
Threads Pipe 1 inch to 6 inches right or left.

MANUFACTURED BY
THE ARMSTRONG MFG. COMPANY
BRIDGEPORT, CONN., *Only*

BADGER TOOL COMPANY

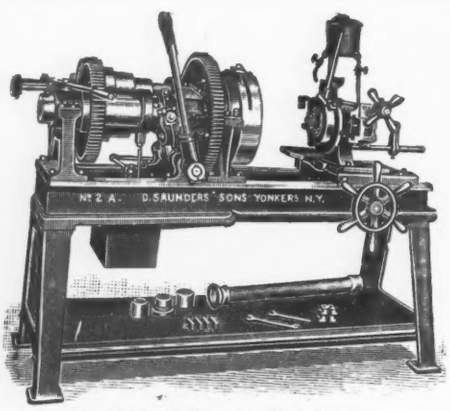
Grinding Machinery Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.

Free from Trouble

Bridgeport Grinders are well designed, generously proportioned and have sturdy, true running bearings. They give 100% satisfaction on the toughest jobs.

The Bridgeport Safety Emery Wheel Co., Inc.
1283 West Broad St. Bridgeport, Conn.



Send for the Saunders Catalog P.

Saunders' Machines for Cutting and Threading Pipe

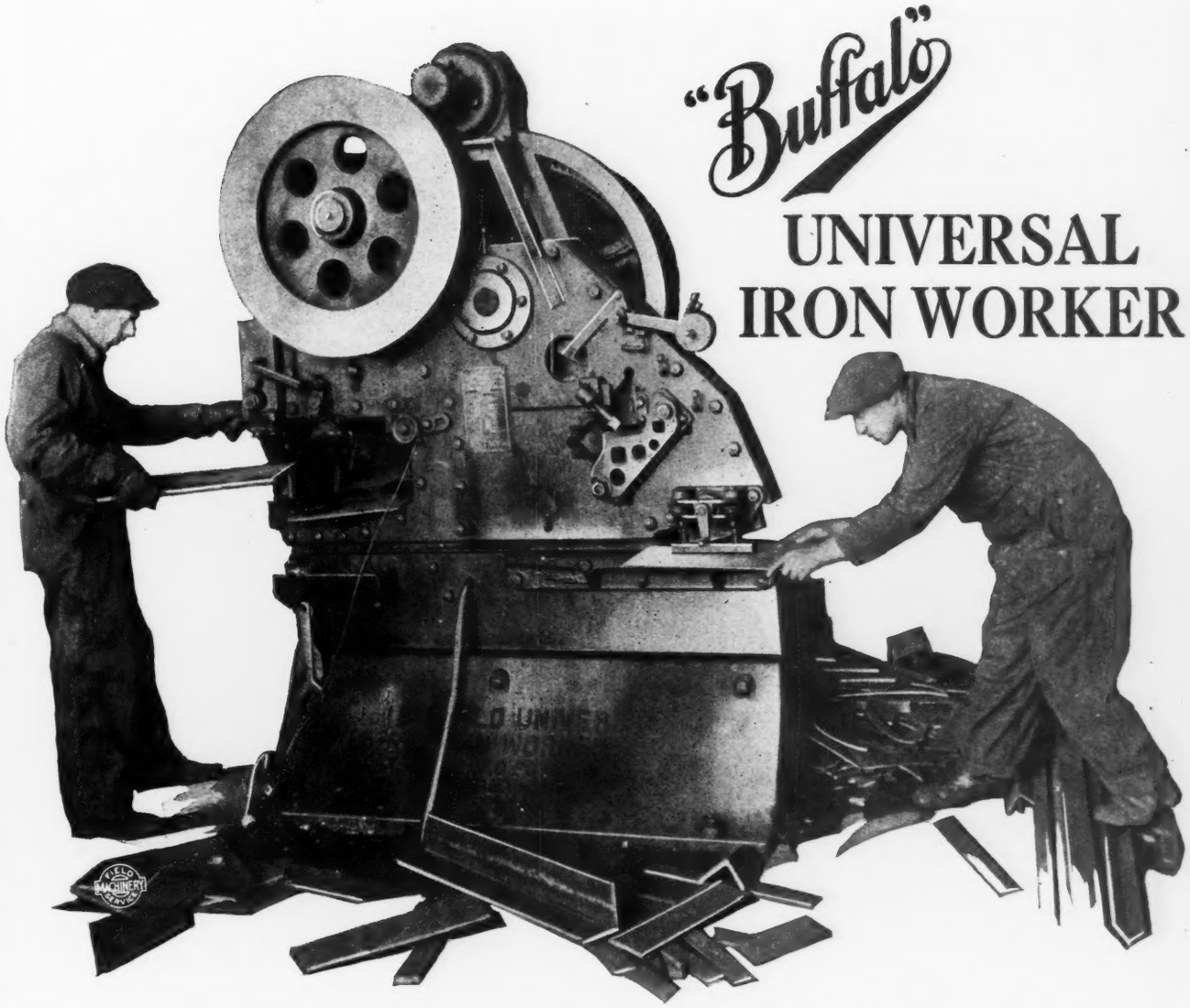
Highly improved production machines adapted to threading pipe and nipples up to 4".

Thoroughly modern, and equipped with countershaft, automatic oil pump; patent lever gripping chuck and two fully adjustable expanding die heads, with interchangeable chasers.

Installations of Saunders' Machines pay for themselves within a very short time.

May we send you details? Catalog on request.

D. Saunders' Sons, Inc., Yonkers, N. Y.



"Buffalo"

UNIVERSAL IRON WORKER

Every Feature Highly Profitable

Slitting shear, punch and bar cutter —one, or all the machines combined in this Buffalo Armor Plate Universal Iron Worker is constantly in operation at the Commonwealth Iron Works, New York City. Hard work and continuous service, meeting demands that are frequently beyond rated capacity limits are no strain at all on this machine—every operation is efficiently performed.

And remember,—owners of Buffalo Machines have the benefit of our convenient location in the center of Industrial America—Extra tools or repair parts, if ever needed, are received in a few days—rather than in weeks or months. All Buffalo Machines are made in America—by American Workmen—from American Materials.

The Buffalo Booklet will give you "Useful Information" on cost cutting metal cutting methods. Send for it.

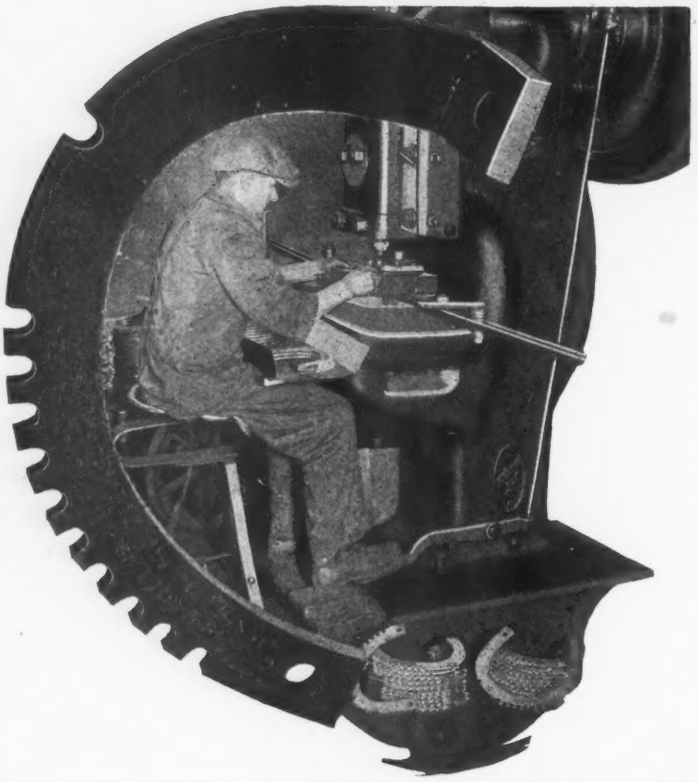
SEE OUR EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20-24
BOOTH 245

Buffalo Forge Company

144 Mortimer Street BUFFALO, N. Y.

In Canada—Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

FERRACUTE PRESSES



"Their speedy action is necessary for our work"

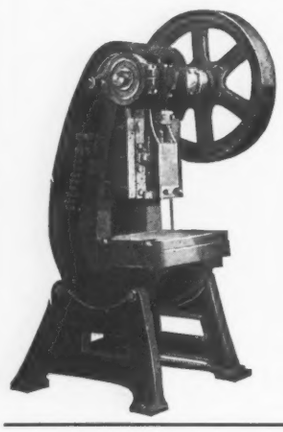
That's the reason given by the superintendent of the Emerson Brantingham Co. for installing Ferracute Presses. These presses have been on the job for a dozen years, handling a wide variety of work. The one shown is notching cultivator quadrants at the rate of 100 per hour. There are eleven notches in each quadrant.

PRESSES FOR
CUTTING
FORMING
DRAWING
PUNCHING
SHEARING
COINING and
EMBOSSING
SHEET and BAR METALS

Ferracute Machine Company
Bridgeton, New Jersey

THE "TOLEDO"
PRESSES FOR EVERY PURPOSE!

Open Back Presses

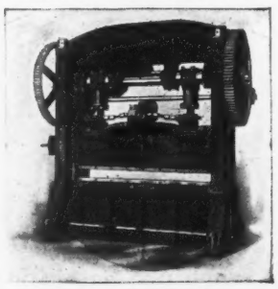


Open Back Presses are an important part of the "Toledo" line. Thirty sizes weighing from 500 lbs. to 30 tons, for blanking, forming, perforating, drawing, shaping, and combination die work.

"Toledo" Presses are made in more than 2000 patterns. If one does not exactly suit your work we will build a special one for you. Tell us your problem.

The Toledo Machine and Tool Company
TOLEDO, OHIO
Chicago Office: 549 West Washington Blvd.
Detroit Office: Room 3-250, General Motors Bldg.
Engineers, Founders and Machinists on
Equipment for Sheet Metal Products

Sheet Metal Working Machinery



L & N
STRAIGHT SIDED
SINGLE and DOUBLE
CRANK PRESSES

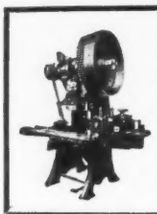
LOY & NAWRATH DIV., BIRMINGHAM IRON FOUNDRY
DERBY, CONNECTICUT
Chicago Office: L. F. Carlton, 549 Washington Boulevard, Chicago, Ill.

Hurlbut, Rogers Cutting-off Machines

Have patented features found in no other machines; speeds and feeds to suit all metals. Capacity to 10" stock.

Write for catalog

THE HURLBUT, ROGERS MACHINERY CO.
Nashua, N. H.



No. 6 ROLL FEED and POWER STRAIGHTENER

Will Feed Stock .137" Thick—4" Wide from 0" to 11" in Length
Specially Adapted for
Hinge and Heavy Hardware Work
F. J. LITTELL MACHINE CO.
4125-27 Ravenswood Ave., Dept. M, Chicago, Ill.

BLISS

SINCE
1857

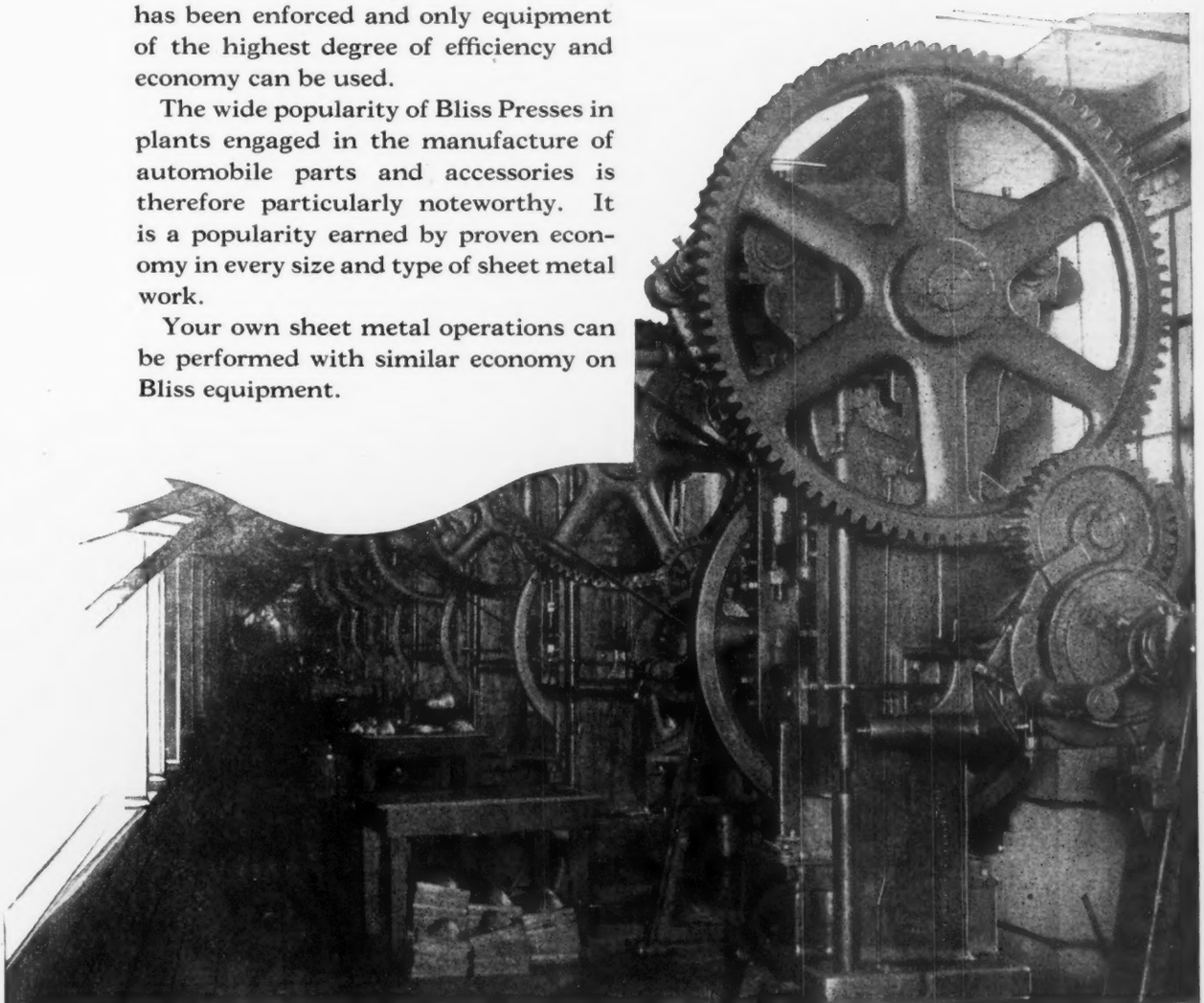
A line-up for economy in sheet metal operations

BLISS *for* MACHINERY

In the automobile industry as in no other, perhaps, costs have been pared to the bone in order to reduce prices so as to meet competition and stimulate sales. The utmost economy of manufacture has been enforced and only equipment of the highest degree of efficiency and economy can be used.

The wide popularity of Bliss Presses in plants engaged in the manufacture of automobile parts and accessories is therefore particularly noteworthy. It is a popularity earned by proven economy in every size and type of sheet metal work.

Your own sheet metal operations can be performed with similar economy on Bliss equipment.



E. W. BLISS CO. MAIN OFFICE AND WORKS **BROOKLYN, N. Y., U. S. A.**

Sales Offices DETROIT General Motors Bldg · CLEVELAND Guarantee Title Bldg. · CHICAGO London Guar. & Accident Bldg. · PITTSBURGH Oliver Bldg. · CINCINNATI Union Trust Bldg. · NEW HAVEN 2d National Bank Bldg. · ROCHESTER Times Union Bldg. · PHILADELPHIA Pennsylvania Bldg.

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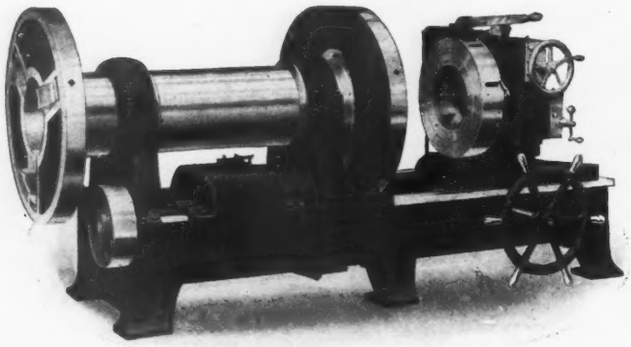


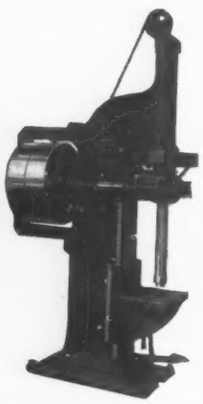
Long Life

ONE of the urgent desires of every human heart is attained in a remarkable degree by BIGNALL & KEELER Pipe Threading Machines. Thirty to forty years of continuous satisfactory service is frequently reported.

Consider this, in connection with the fact that BIGNALL & KEELER Machines lead the procession for speed and accuracy. Then let us send full descriptive literature.

Bignall & Keeler Machine Works, of the N. O. Nelson Mfg. Co
EDWARDSVILLE, ILLINOIS.

Ideal for Straightening



20 Ton Press

The "Flexible" Power Press performs straightening operations easily and economically.

Exactly the correct pressure may be applied, up to the capacity of this machine. The downward movement of the ram is controlled by a foot treadle, and continues as long as the treadle is held down. Overload and injury to the machine are prevented by the slipping of the brake band which controls the drive of the ram. Both the operator's hands are free to handle the work. The machine is fast, productive, and profitable.

Also well adapted to pressing in bushings, and many short broaching operations. Made in sizes to deliver pressure up to 20 tons. Send for bulletin with full description.

GENERAL MANUFACTURING CO.
6436 Farnsworth Ave. DETROIT, MICH.

Power Punching and Shearing Machinery

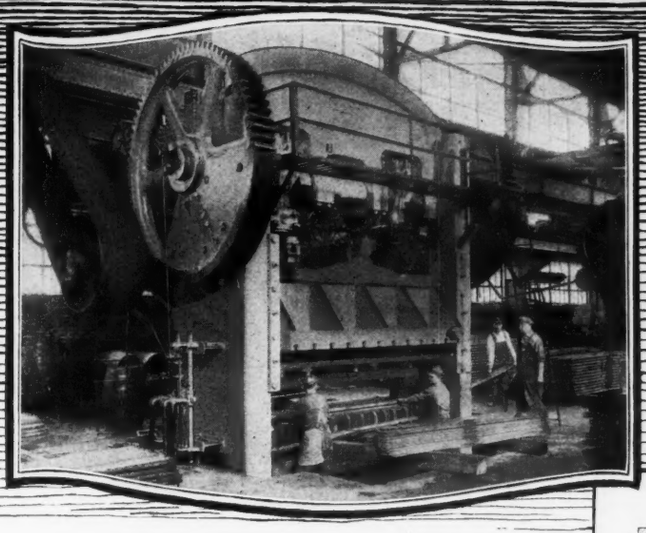
SPACING TABLES
FOR WORKING PLATES, BARS AND STRUCTURAL SHAPES

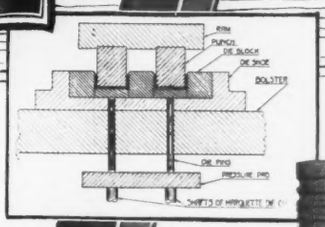
The Long & Allstatter Company
HAMILTON, OHIO

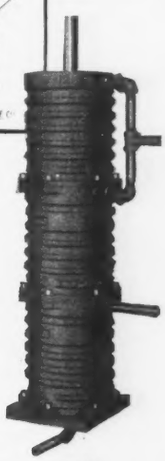
"CHICAGO" PIPETHREADING MACHINES
Production—Precision—Portable
Latest and most advanced types on the market.
Send for catalog
Chicago Pipethread Machine Co.
Offices and Factory:
1619 RACINE STREET RACINE, WIS., U. S. A.

FRENCH HYDRAULIC MACHINERY
PIQUA OHIO

Increases Speed of Operations







MARQUETTE Pneumatic Die Cushions speed up operations on heavy work such as producing side rails for automobile chassis.

The blank is laid across the die and descending punch forms the channel, the blank being prevented from bulging away from the punch and slipping to one side by pressure pads supported by the Marquette air cushions.

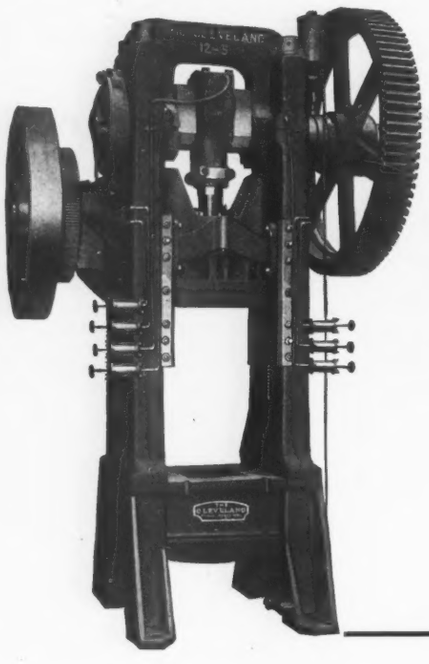
After the punch has left the channel, pressure is automatically applied from below to lift out the finished job and allow time for inserting another blank, while the press is still on the up stroke, making possible continuous operation. In this fashion 14 perfect side rails are drawn per minute. (2 a stroke, 7 strokes a minute.)

By eliminating spoiled blanks and saving both the operator's time and press delays, Marquette Pneumatic Die Cushions have made possible economies unknown with spring or rubber bumper equipments.

Marquette can effect similar savings for you whether you're drawing big heavy work like this or some kind of a thin tin cap. Send sample of the part or blue print of it to our Engineering Department with a few details as to equipment you have, etc.; they will study your problem and make important money saving suggestions without cost or obligation to you.

Marquette
TOOL & MFG. CO
CHICAGO
321 W. Ohio Street

Use Marquette Pneumatic Die Cushions—they enable
You to
MAKE SINGLE ACTING PRESSES DO THE WORK OF DOUBLE ACTING
DO SEVERAL OPERATIONS IN ONE STROKE OF THE PRESS
MAKE ONE PRESS HANDLE MANY DIFFERENT TYPES OF WORK
USE CHEAPER MATERIALS AND STILL PRODUCE EQUALLY GOOD OR BETTER SHELLS
ELIMINATE WRINKLED STAMPINGS AND HAND HAMMERING COSTS
MAKE DEEPER DRAWS THAN EVER BEFORE
INCREASE SPEED OF OPERATIONS AND DECREASE OPERATING COSTS



CLEVELAND PRESSES

Correct Design
Rigid Construction
Quality Materials
Low Upkeep
Economical Production
Careful Workmanship

CLEVELAND POWER PRESSES

Whatever your power press requirements may be we can furnish a Cleveland to meet them.

NEW YORK
30 Church Street

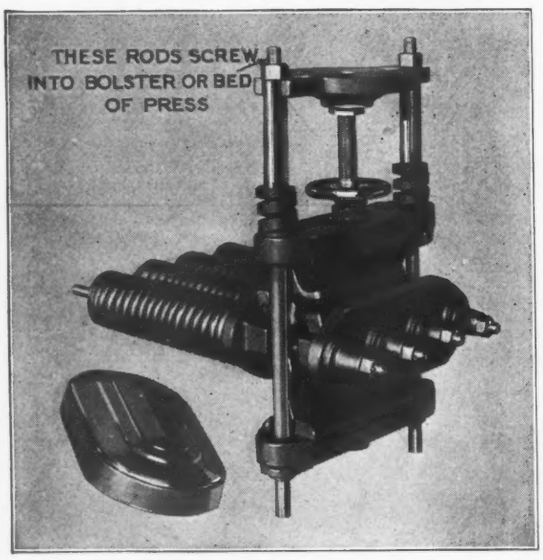
CHICAGO
80 E. Jackson Blvd.

The CLEVELAND PUNCH & SHEAR WORKS CO.
Main Office & Works CLEVELAND, OHIO
PITTSBURGH - CHICAGO - PHILADELPHIA - NEW YORK

PHILADELPHIA
321 Bulletin Bldg.

PITTSBURGH
511 Farmers Bank Bldg.

The King Pressure Toggle



This boiler cover was blanked, drawn and embossed in one operation in a single action press equipped with a King Pressure Toggle. A Permanent Attachment that equips a Single Action Press to produce Toggle Press jobs.

R. D. KING **Chicago, Ill.**
1620 Monadnock Block

WILLIAMS, WHITE & CO.
MOLINE, ILLINOIS, U. S. A.

Angle Bending Rolls
Bulldozers
Drop Hammers
Eyebenders
Forging Presses
Forging Hammers
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Multiple Punches
Punches & Shears
Plate Shears
Tie Rod Presses
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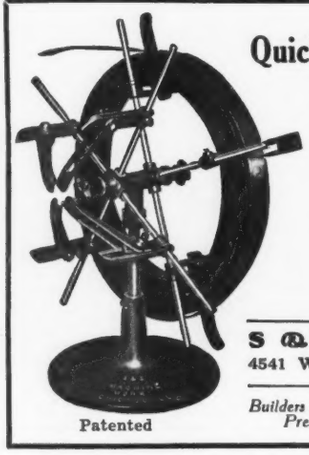
OSTERHOLM SURFACE GRINDER
SPECIAL MACHINERY


Patented

Quick S&S Loading

DOUBLE SWIVEL REELS for use with roll feeds, etc.
SINGLE INCLINABLE REELS for hand feeding.
HORIZONTAL REELS for round wire.
DISC REELS for brass, copper, etc.

S & S Machine Works
4541 W. Lake Street, CHICAGO, ILL.

Builders of Precision Automatic Feeds for Punch Presses and Metal Working Machinery.

What have you to form or cut from sheet metal? Write and we will send Bulletin and other information about the correct machine.

CERTAINTY for Production Quotas

Count on parts moving to assembly with absolute regularity when you employ Niagara Production Machines. For wide practical experience has taught us to build into them strength, without clumsiness, to stand the "pushing" they will get much of the time in many a plant.

NIAGARA MACHINE & TOOL WORKS

637-697 Northland Ave., Buffalo, N. Y.

Philadelphia
617 Harrison Bldg.

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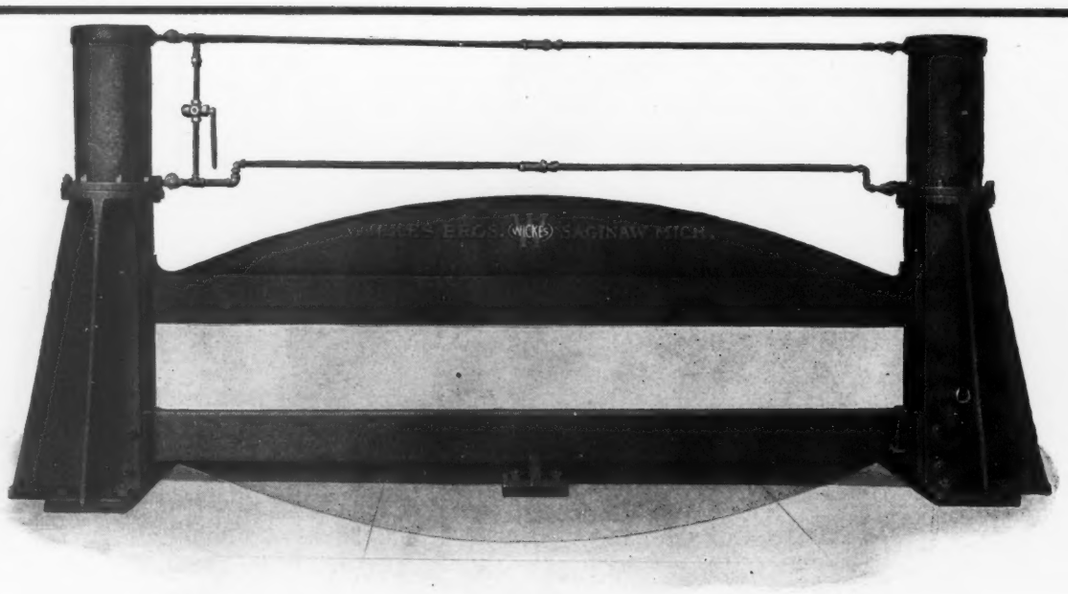
NIAGARA



Wickes Full Pneumatic Flanging Clamp
Built in any length desired.

WICKES BROTHERS

Established 1856

Saginaw Michigan

New York Office
501 Fifth Ave.

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736 White Henry Bldg.

OTHER PRODUCTS:
Plate Bending Rolls
Angle Bending Rolls
Plate Straightening Rolls
Punching & Shearing Machinery
Flanging Clamps
Radial Wall Drills
Crankshaft Turning Equipment
Heavy Duty Engine Lathes
Blue Printing Machines

FEDERAL PRESS CO., ELKHART, IND.

FEDERAL

POWER PUNCH PRESSES

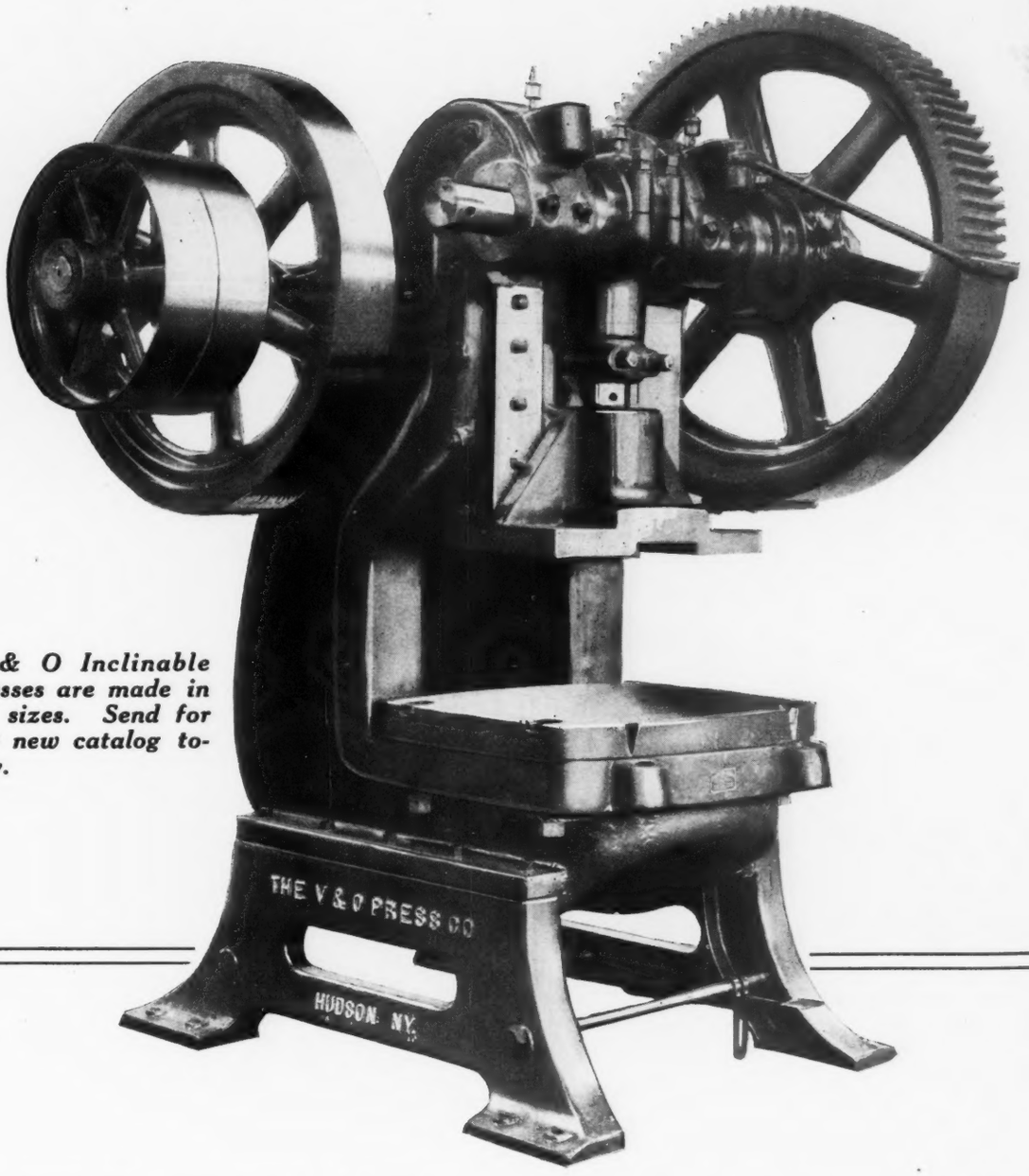
for sheet metal stampings and shallow drawings of all kinds.

STRENGTH and RIGIDITY
are inherent qualities of Federal presses.

Circular on request.

FEDERAL PRESS CO., ELKHART, IND.

V & O Power Presses



V & O Inclinable Presses are made in 20 sizes. Send for our new catalog today.

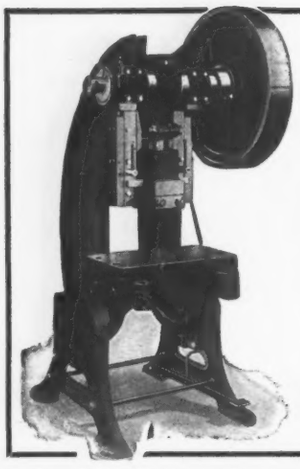
THE pounding of hard continuous operation is easily withstood by this staunch No. 6 Geared Press. This machine is built expressly to give uninterrupted service; the accuracy of heavy stamping is the same at the end of a long run as at the beginning.

The V & O No. 6 can be depended upon, from the advent of its installation, for accuracy, economy, durability and safety.

THE V & O PRESS COMPANY, Hudson, N. Y., U. S. A.

Sales Agents:

HENRY PRENTISS & COMPANY, New York, Hartford, Boston, Syracuse, Rochester, Buffalo.
THE MOTCH & MERRYWEATHER MACHINERY CO., Cleveland, Detroit, Cincinnati, Pittsburgh.
MARSHALL & HUSCHART MACHINERY CO., Chicago. ELLIOTT & STEVENS MACHINERY CO., St. Louis.



NOTICE!

A LOSHBOUGH-JORDAN PRESS Goes to Trial

The Verdict—

Cincinnati, Ohio
March 23d., 1926

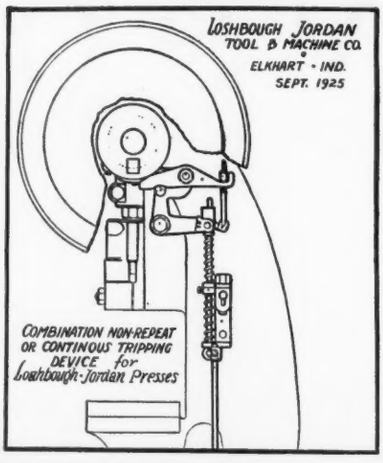
Loshbough-Jordan T. & M. Co.,
Elkhart, Ind.,

Gentlemen:

Enclosed find our check covering your invoice of Feb. 5th, and we are glad to state that this press is giving us perfect satisfaction. When in the market again, you will hear from us.

Very truly,
THE GUSTAVE FOX COMPANY,
(Signed) Leonard J. Fox, Pres.

Loshbough-Jordan Tool & Machine Co.
ELKHART, INDIANA


LOSHBOUGH JORDAN
TOOL & MACHINE CO.
ELKHART · IND.
SEPT. 1925
COMBINATION NON-REPEAT OR CONTINOUS TRIPPING DEVICE for Loshbough-Jordan Presses

What Is Your Problem?

Write for prospectus listing the Pexto big line of Hand and Power Machines for facilitating sheet metal working operations—Then check the Bulletins of interest. Let our Engineers help solve that problem.

PUNCHING, WIRING and SEAMING PRESSES

PEXTO

DIES a Specialty

THE PECK, STOW & WILCOX CO.
SOUTHINGTON, CONN., U. S. A.

The Skill is All in the Machine

Rotary Swaging is the modern and economical method of forming solid or tubular circular metal sections without waste of stock. The Langelier Swaging Machine reduces or tapers to a circular section, square, round, hexagonal, or similar shapes, hot or cold. We build special swaging equipment for Tungsten Filament Wire.

Our policy is to equip the machines in every detail with work holding and feeding devices that will enable them to give the most efficient service with unskilled help at a low upkeep cost.

Machines built to date have capacity ranging from a pin point to 2½" diameter on solid stock, and to 6" on tubing.

LMCo. **LANGELIER MFG. COMPANY**
Arlington, Cranston, R. I., U. S. A.

AUTOMATIC BAIRD MACHINE CO. BRIDGEPORT, CONN. MACHINERY

PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard and Special.
TUMBLING BARRELS—All kinds.
BALL BURNISHING EQUIPMENT.
AUTOMATIC CHUCKING MACHINES.

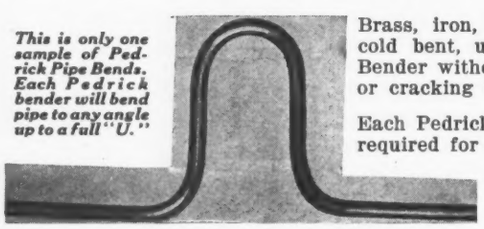
THE BAIRD MACHINE CO.
BRIDGEPORT, CONN.

CHAMBERSBURG

Steam, Steam Drop and Board Drop Hammers
Trimming Presses Punches and Shears
Hydraulic Machinery of all types and sizes, including Presses, Riveters, Pumps, Accumulators and Special Machinery

Chambersburg Engineering Co., Chambersburg, Pa.

It's Much Cheaper to Bend Your Own Pipe!



This is only one sample of Pedrick Pipe Bends. Each Pedrick bender will bend pipe to any angle up to a full "U."

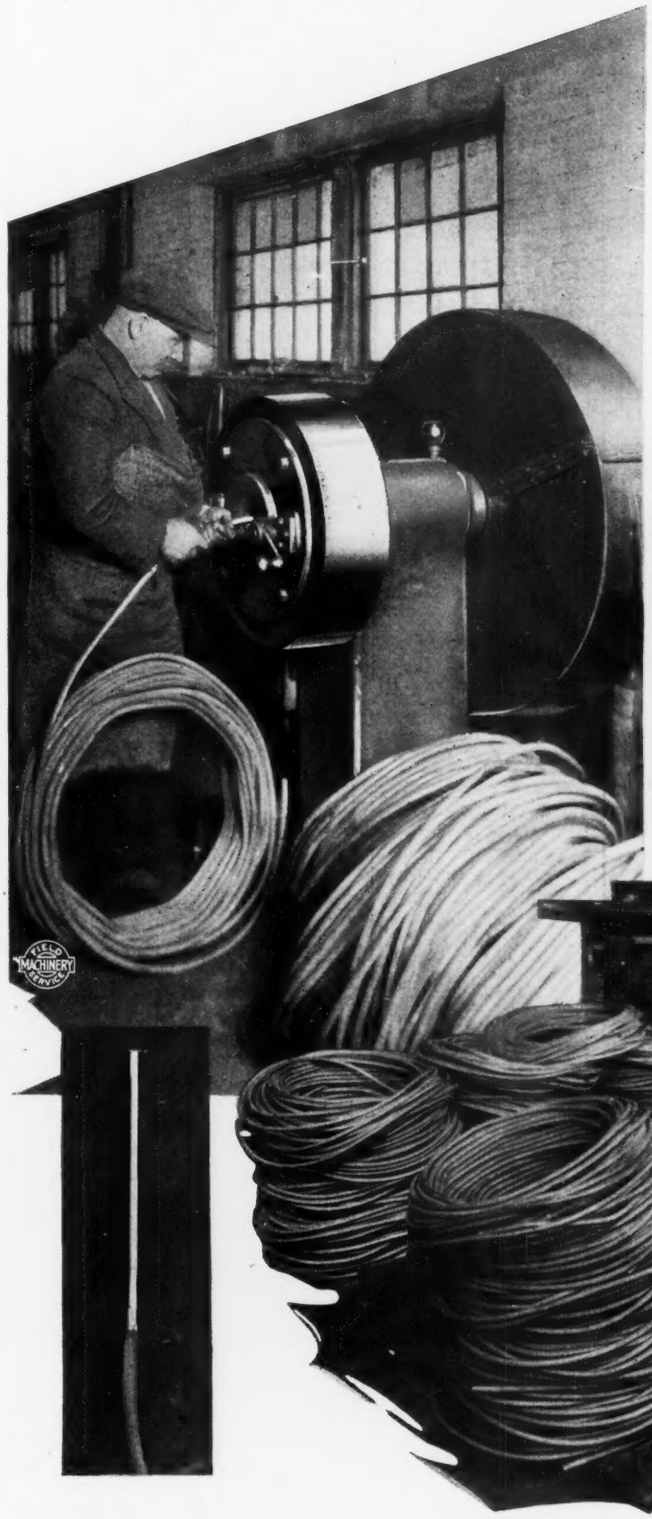
Brass, iron, copper, steel or galvanized pipe can be cold bent, unloaded, with a Pedrick Horizontal Pipe Bender without danger of crinkles, flatness, distortion, or cracking the outside coating.

Each Pedrick Pipe Bender is equipped with the 4 rolls required for pipe 1", 1¼", 1½" and 2". Any bend up to 180° can be handled. Rigidly constructed, simple in operation.

Motor Driven. Also built in two hand operated sizes.

PEDRICK TOOL & MACHINE COMPANY
3639 N. Lawrence Street, PHILADELPHIA, PA.

Dayton (Torrington) Swaging Machines



Torrington Swaging at the Bridgeport Brass Company

Several Dayton (Torrington) Swaging Machines form part of the modern equipment in the plant of the Bridgeport Brass Company, Bridgeport, Conn. They are kept busy pointing the ends of extruded brass, bronze and copper alloy rods to permit them to enter the reducing dies of cold drawing machines.

The particular machine shown here has a capacity for swaging material from 5/8" to 3/4" diameter and has been in continuous operation on an average of fifty hours a week for years. The work is reducing .568" diameter Ledrite brass rod down to 7/16" diameter—7 inches—at the rate of 30 seconds an end.

This is just an example of the economies hundreds of other Dayton (Torrington) Swaging Machines are effecting on a wide variety of swaging operations.

Send for estimates of your work
Dayton (Torrington) Swaged

THE TORRINGTON CO. Excelsior Plant: 57 Field St., Torrington, Conn.

SUCCESSORS TO EXCELSIOR NEEDLE CO.

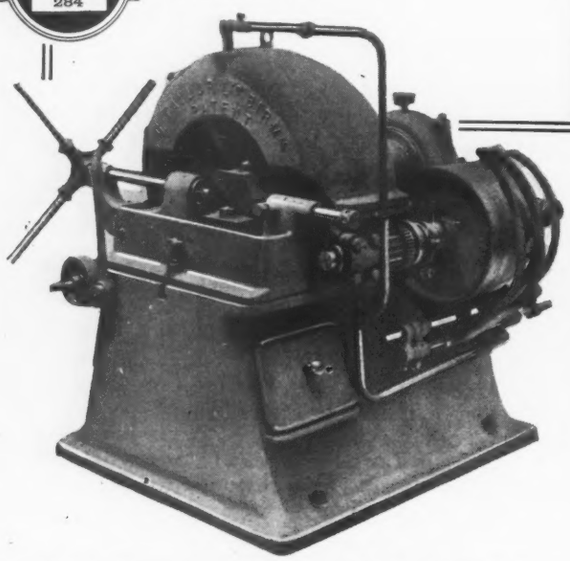
Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Roycroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

NEW

Rotary Cutting-Off Machine

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20-24
BOOTH NO. 284

with cutter head employing 2 balanced cutting tools rotating around the work, which is held stationary.



The Fastest All-Around Cutting-Off Machine in the World

on bars—round, square, hexagon etc.—and tubes.

Average output obtained in actual service:

4½" round mild steel bars cut off in 50 seconds
2" square " " " " " " 35 seconds
2" gas tubes " " " " 18 seconds

Expressly built for use by UNSKILLED LABOR.
Simple operation—Nothing to get out of order.

You should investigate this machine at once and compare it with your present equipment.

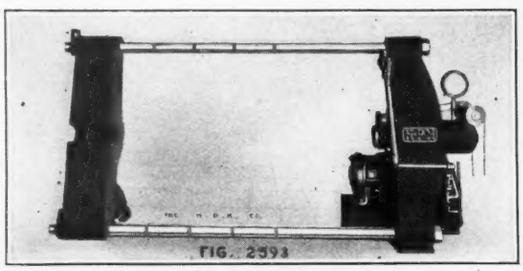
Made in 3" and 4½" sizes.

Also:
S & S Gear Hobbing Machines,
Worm and Thread Milling Machines,
Semi and Full Automatic Hob Grinders,
Carl Zeiss Measuring Tools.

Schuchardt & Schutte of New York
GEORGE SCHERR CO.
142 Liberty Street New York

DO YOUR ASSEMBLING The H-P-M HIGH PRESSURE WAY!

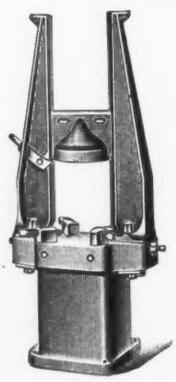
Machine parts assembled with a force fit hold safe and sure—when the work is done with an H-P-M HIGH PRESSURE HYDRAULIC Press. The forcing pressure is positively indicated and accurately controlled, with the job quickly finished.
There is an H-P-M Press for *your* forcing job.



THE HYDRAULIC PRESS MFG. CO.
ENGINEER BUILDERS SINCE 1877
48 LINCOLN AVE.
MOUNT GILEAD, OHIO

H-P-M
HIGH PRESSURE HYDRAULIC
PUMPS **PRESSES** VALVES

"FOR YOUR PRESSING NEEDS"



"PECK" DROP PRESSES

For All Purposes

Automatic Drops
"Peck" Automatic Lifters

Miner & Peck Mfg. Co.
Division of
Birmingham Iron Foundry
DERBY CONN.

MERRELL

Pipe Threading and Cutting Machinery

Hand or Power Operated

THE MERRELL MFG. COMPANY
15 Curtis Street TOLEDO, OHIO

Broaching Tools and Broaching Machines of all Sizes and Descriptions
Quality and Service

American Broach & Machine Co.
Ann Arbor Michigan
Builders of All Types of Broaching Machines and Broaching Tools

"The best pipe-threader I have ever seen is this RAPIDUCTION"

reports FRED STIRINGER
RAPIDUCTION operator at the Union Iron Works

—and the same day that this picture and report reached us, we got another report of the same kind from Tulsa, Oklahoma! Geography has nothing to do with the extra output and lower operating cost of the RAPIDUCTION.

Mr. Stiringer of Union Iron Works of Erie, *knows* pipe threading machines! —because ten feet from his busy RAPIDUCTION is another power threader. But this other machine has not been operated for months; the RAPIDUCTION does practically all the pipe threading for this nationally known boiler company.

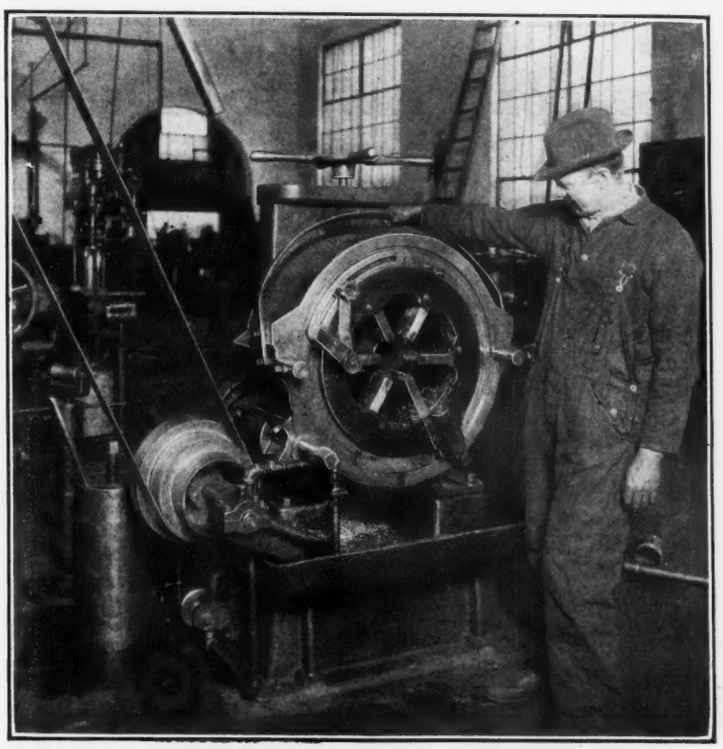
Faster threading—no change of die head—small inexpensive chaser bits—largest size bearings (and they're self-oiled cast iron spindle bearings)—compactness—that's the RAPIDUCTION.

Send for the RAPIDUCTION booklet, and note the savings the machine has in store for your plant.

WILLIAMS TOOL CORPORATION, ERIE, PA.

List of Dealers Who Handle Williams Tool Line Exclusively

Manning, Maxwell & Moore, Inc. New York, N. Y., Pittsburgh, Philadelphia, Boston, Birmingham, Buffalo.
Harron, Rickard & McCone Co., San Francisco, Cal., Los Angeles, Cal.
Peden Iron & Steel Co., Houston, Texas.
Oliver H. Van Horn Co., New Orleans, La.
E. A. Kinsey Co., Cincinnati, Ohio.
Jos. T. Ryerson & Son, Chicago, Ill.
Oil Well Supply Co., Pittsburgh, Pa.
Portland Machinery Co., Portland, Ore.
Seattle Hardware Co., Seattle, Wash.
Chas. A. Strelinger Co., Detroit, Mich.
English Bros. Machinery Co., Kansas City, Mo.



No. 108—Belt-Driven—Range 2½—12"

At Dunmore Colliery of the Pennsylvania Coal Company this new Curtis Pipe Cutting and Threading Machine has recently replaced a Forbes (old name for Curtis machine) which had been giving wonderful satisfaction for over 30 years. What an enviable record to have.

Tremendous Economies

obtained in a Modern Plant by using a new

Curtis *Pipe Cutting and Threading Machine*

Times change—new practices and improved machinery are making possible big economies and improvements. To obtain these savings Dunmore, a year ago, installed this new model Curtis Pipe Cutting and Threading Machine.

A saving of 4/5 of the floor space and ½ the power consumption was obtained by using this compact, light weight and rapid operating machine. Operation is simple so that a semi-skilled operator can obtain the maximum output. You can depend on the Curtis to do the job the right way.

Complete line of Hand—Belt—Electric Machines. Ranges from ¼-2" to 8-16".

THE CURTIS AND CURTIS CO.
324 Garden St., Bridgeport, Conn.

MOST THREADS PER DOLLAR INVESTED

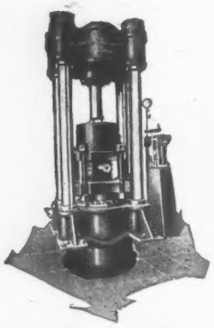
HYDRAULIC EQUIPMENT

For Special Purposes

We build complete hydraulic plants including pipe, valves, pumps, accumulators, intensifiers, and presses for every purpose such as:

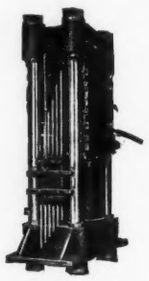
Forming
Dehydrating
Thermo Plastic Moulding
Blocking and Extruding
Briquetting
Baling
Clay Forming
Sagger Moulding
Moulding and Vulcanizing
Oil Extracting
Cocoa Butter Extracting
Compressing and Forming, etc.

Write for Bulletins.

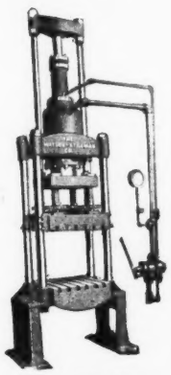


2100 Ton Lead Press for covering cable and vulcanizing rubber hose.

Curb Press for Reclaiming Liquid Products.



Multiple Plate Heating Press



Rapid Working Press for Bakelite Redmanol condensite, etc.

The Watson-Stillman Co.

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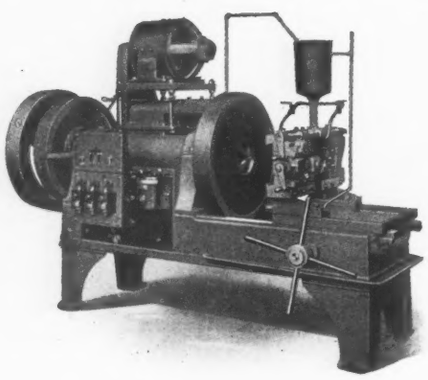

A Cox 6" Class "D" Motor Driven Pipe Threading and Cutting Machine. (This machine can also be had in Belt Drive.) It will handle pipe from 1" to 6" inclusive and requires only 5 H.P. for operation. Six different Spindle Speeds are available, and Die Pockets, Wrenches and a complete set of Standard Expansion Dies are part of equipment.

You don't have to re-set chasers for different Pipe sizes on Cox Machines

With every Cox Pipe Cutting and Threading Machine, there is furnished Standard Die Heads for each pipe size, within the capacity limits of the Machine. This saves considerable wastage of time and yet is only one of the many advantages of COX MACHINES.

Simplicity of operation, Quality and Quantity Production, Low Maintenance Cost and Extremely Long Service Life are all assured the user of COX MACHINES. They're available in Belt, Motor, Steam or Gasoline Engine Drives; in sizes from ¼" to 24" Pipe.

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SCRAP METAL BUNDLERS

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High Speed Riveting Hammers usually pay for themselves in 100 days or less! If you send us samples of your work for production and cost estimates, you will understand why!

Good Work on Textile Machinery

The double installation of High Speed Riveting Hammers at the Textile Machine Works, Reading, Pa., is producing smooth, strong, dependable rivets in parts for complicated weaving and braiding machines—doing fine work and fast work that pleases and *pays*.

The job shown, is riveting together the bottom lug and plate for the foot of a braid machine carrier. The joint is a tight fit.

THE PRINCIPLE IS RIGHT

THE HIGH SPEED HAMMER COMPANY, Inc.

ROCHESTER NEW YORK

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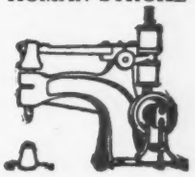
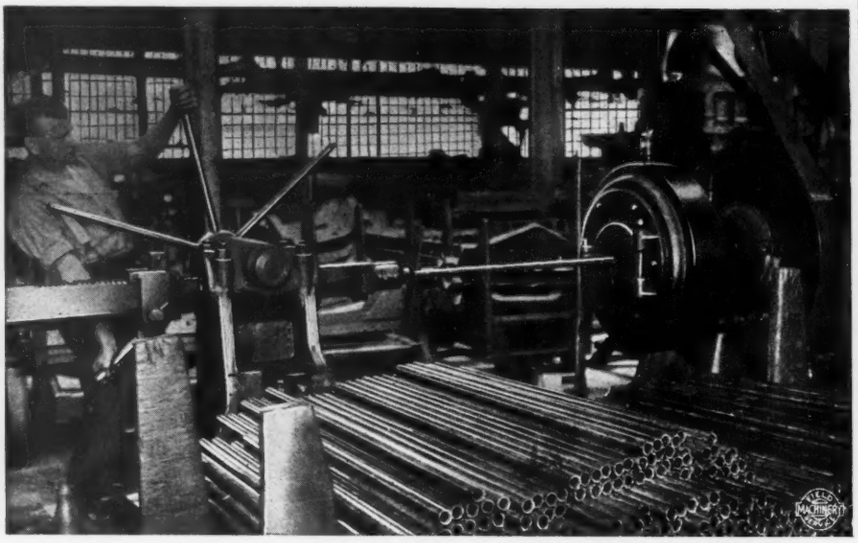
THE HAMMER WITH THE HUMAN STROKE



Rushing Production with

Etna Swagers



Eight hundred 1⅛" tubes per hour is the production pace set by four Etna Swagers in the plant of the A. O. Smith Company at Milwaukee, where steel tubing of various oversizes must be swaged down to uniformity, for use as tie rods on Automobile chassis.

As the entire plant's production is dependent upon these Etna Swagers they must produce constantly and with great speed. In the photograph the operator is seen forcing a tube into the rotating dies of the Etna.

If you have any work that can be swaged it will pay you to get the details of Etna Swagers. Sent on request.

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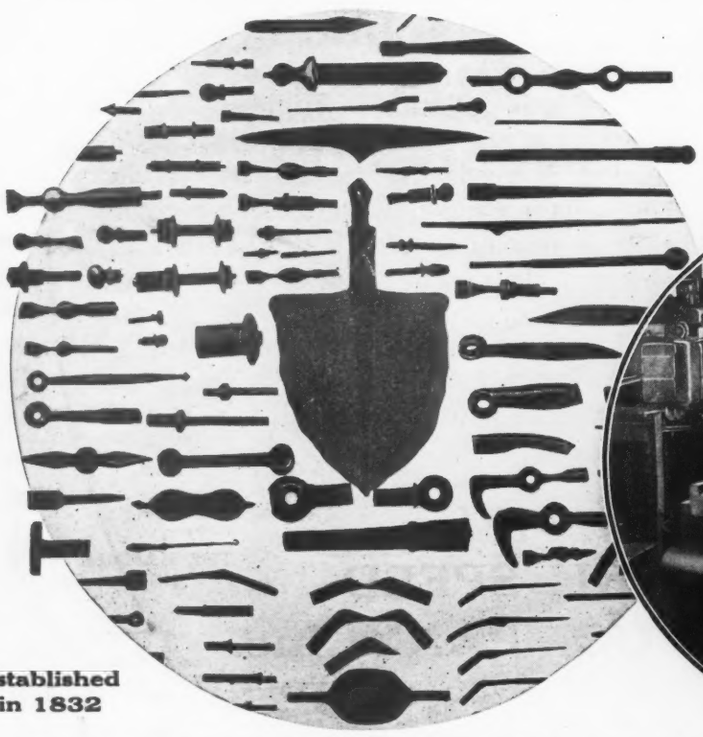
BRADLEY HAMMERS

for

All Kinds of Forgings



Established in 1832

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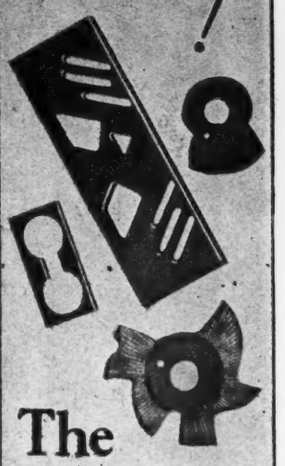
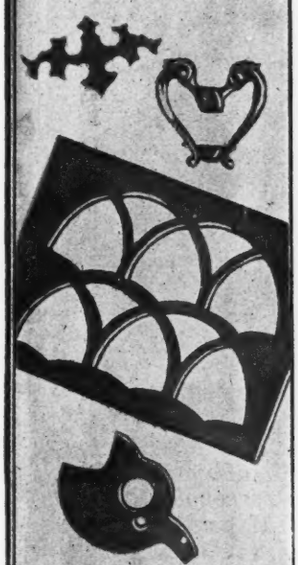
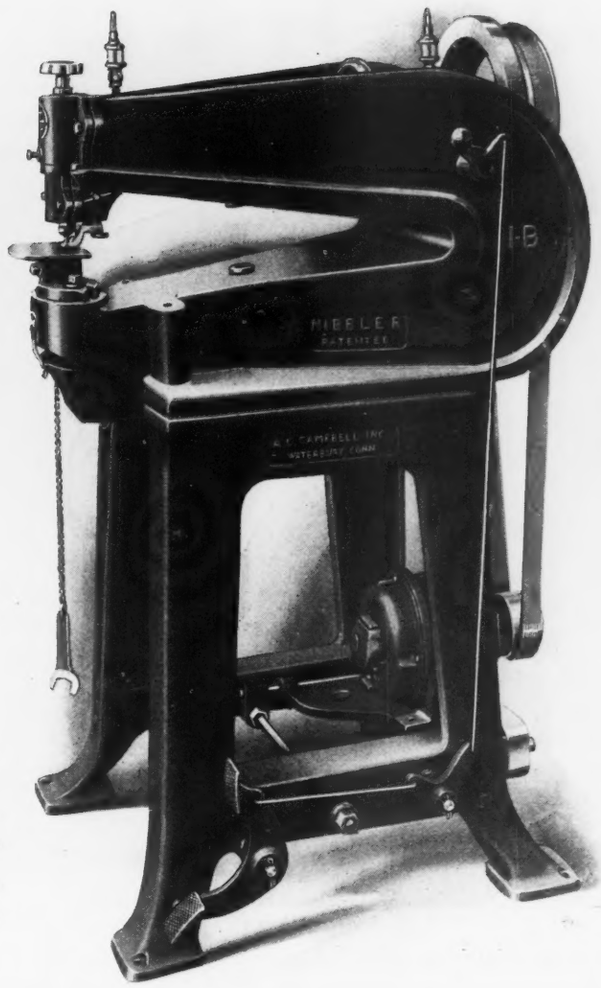
"Nibbles" pieces *like these!*



The Campbell Nibbling Machine *handles sheet metal and composition materials*





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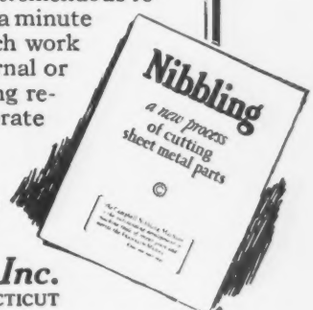

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Read how this remarkable machine has paid for itself in other shops, and what owners have to say about it.

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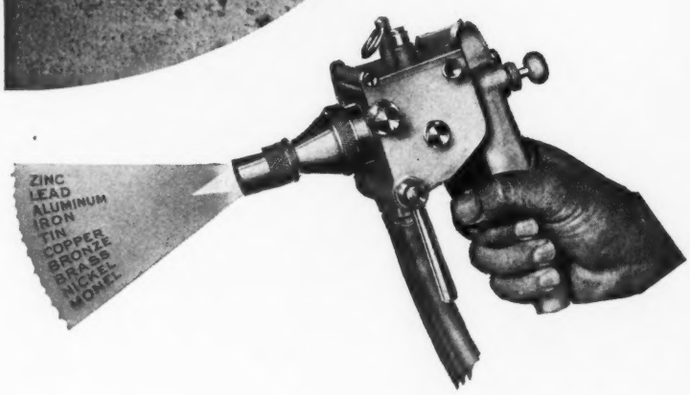

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UMA No. 1 is suitable for case hardened gears, pins, shafts, roller bearings and all parts requiring a very uniform, hard case.

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We also have daily production in all kinds of Agathon Alloy Steels such as—

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Three Times the Production from These Intra Steel Dies

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Think! Can *you* take advantage of these money-making properties of Intra Steel?

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103 Duane Street, New York City

BOSTON **CHICAGO** **CLEVELAND**

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TOOL STEELS

A Mark

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You, too, will find this same satisfaction in Colonial.

Colonial Steel Company

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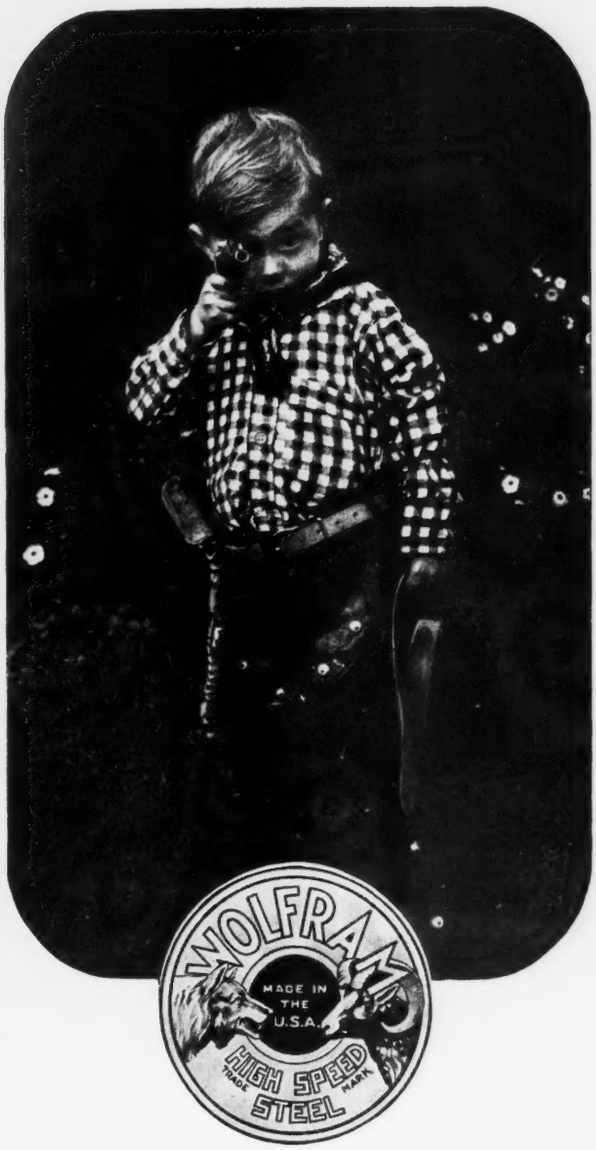
Cincinnati Detroit Chicago St. Louis Salt Lake City



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YOU can't help throwing up your hands when you find out how much money you could have saved during the past few years by using Vulcan Special Vanadium Tool Steel to replace your Straight Carbon Steel for dies, punches, shear blades and similar tools.

The decidedly marked ability of Vulcan Special Vanadium Tool Steel to withstand wear has compelled its use when longer life tools are required to take the place of those now made from straight carbon steel.

Those who use Vulcan Special Vanadium steadfastly maintain that it outwears and outwears Straight Carbon Steel. *They ought to know.*

Vulcan Special Vanadium Tool Steel

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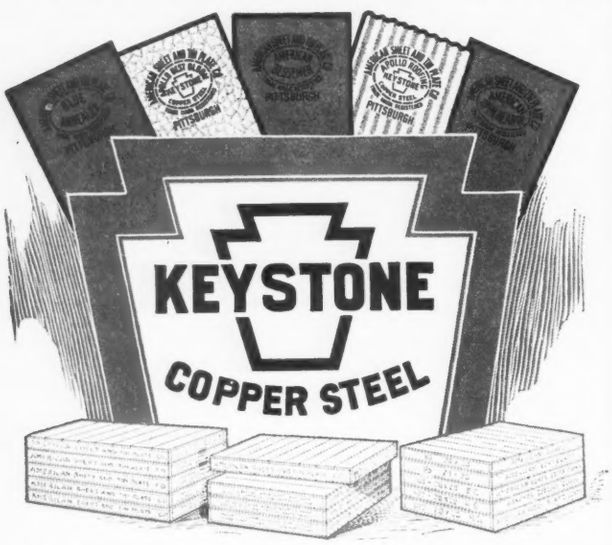
FOR ALL PURPOSES



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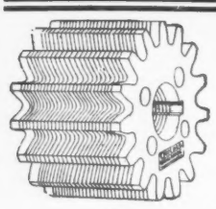

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Our "Chicago Rawhide" Mallets and Hide-Faced Hammers are non-conductors—they can't damage fine surfaces or soft metal work—just what you've been looking for. We also make Belting, Lace Leather, Cut Lacing, Hydraulic Packing.

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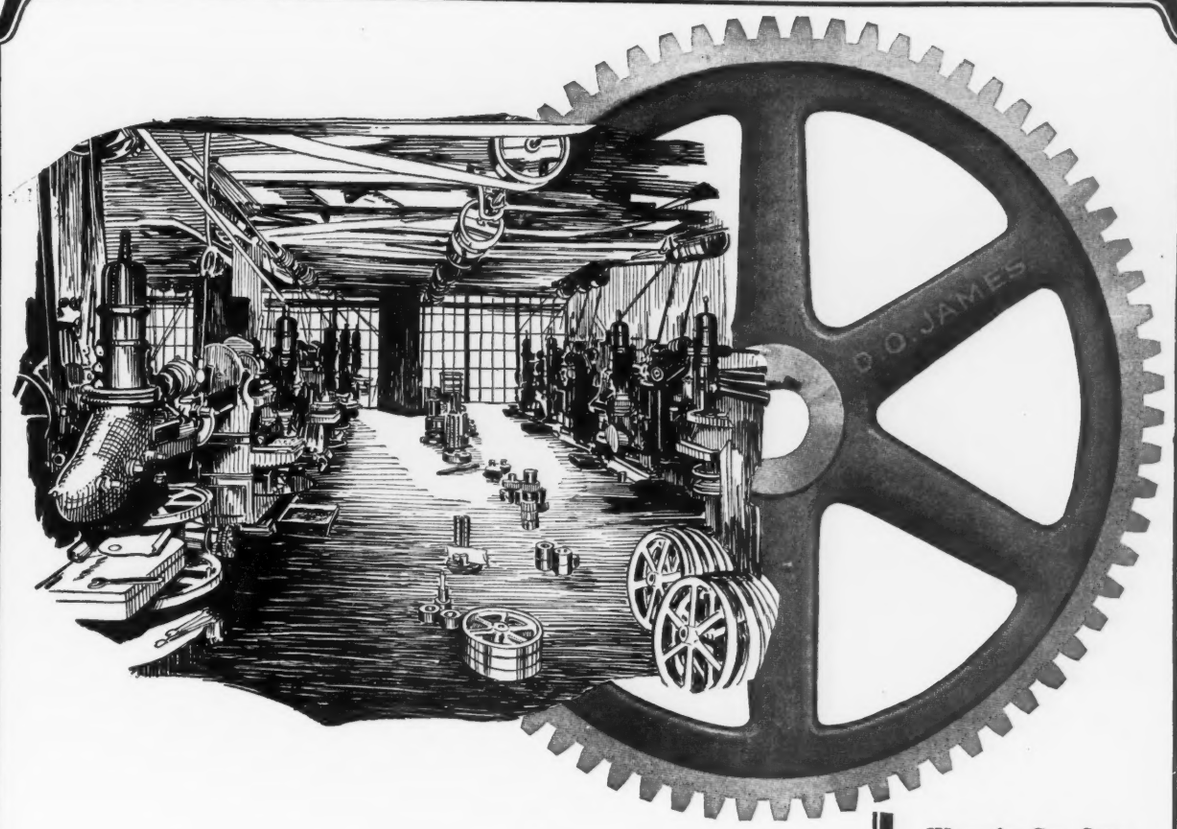

Long Life Gears

James "Long Life Gears" have quality inbuilt — a habit with us rather than a special effort. Made of the best materials — by men of long experience — and according to standards dictated by more than 40 years of specialization — they are a guarantee of long time, trouble-free operation.

Our facilities are most complete for making Spur, Bevel, Mitre, Helical, Herringbone, Spiral and Internal Gears of any material and in any quantity. Our prices are as low as is consistent with quality. Our service, because of our enormous capacity, is beyond competition.

Let us make your next order of gears. If they are standard size buy from our Catalog No. 99 (* have you a copy?) If they are special — let our Engineering Department help you with their design. The services of this department are gratis.

*Where shall we send the catalog?

D. O. JAMES MANUFACTURING COMPANY
1120 West Monroe Street, Chicago, Illinois

We make Cut, Spur, Bevel, Mitre, Helical, Herringbone, and Internal Gears of Cast Iron, Steel, Bronze, Bakelite, Fibre, Rawhide and other materials.

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D.O.JAMES

The New Ganschow Worm Gear Power Transformer

The William Ganschow Company presents this advanced type of worm gear speed transformer, permitting heavier and more constant service, as well as wider load fluctuation, than has ever been found practical with previous types of worm gear speed reducers.

Greater efficiency, dependability, and flexibility, coupled with the wider range of applications, are features worthy of your investigation. Our very complete engineering service is available, and we will gladly help you to apply Ganschow Worm Gear principles to your speed reduction problems.

Ask for the new Ganschow Worm Gear Speed Transformer Bulletin.

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16 North Morgan Street, Chicago
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SPEED TRANSFORMERS
CUT GEARS · FABROIL NOISELESS PINIONS

Gears

Meritorious products win attention and desire for their possession—their cost is paid willingly—even without comparison—since they are ultimately the most satisfactory. We guarantee no corrective work will need to be done by you on our products—that means they are 100% to specifications. There is faith for you; built into our products and acknowledged by repeat orders and new clients who have needed and have seen and heard of this quality, and who come seeking and continue with us for their profit and complete satisfaction. You too need the advantage of this quality—take it.

We solicit inquiries for small or any quantities of gears of all kinds, and for contract machine work, and we especially solicit that high grade in which "Confidence in Sustained Quality" is of paramount necessity.

We render engineering service too, that solves your problems as they should be.

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"SUPERIOR"

Rough Rawhide Gear Blanks

The following reliable gear manufacturers stock our "SUPERIOR" Rawhide Blanks so we say, **"Get service** from your nearest **Gear Cutter** on Rawhide Gears"

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Cincinnati Gear Co.	Cincinnati, Ohio
Crago Gear & Machine Works	Kansas City, Mo.
Diefendorf Gear Corp.	Syracuse, N. Y.
Wm. Ganschow Co.	Chicago, Ill.
Horsburgh & Scott Co.	Cleveland, Ohio
D. O. James Mfg. Co.	Chicago, Ill.
Johnson Foundry & Machine Co.	Los Angeles, Cal.
Keystone Engineering Co.	Los Angeles, Cal.
Newark Gear Cutting Mach. Co.	Newark, N. J.
Pacific Gear & Tool Works, Inc.	San Francisco, Cal.
Philadelphia Gear Works	Philadelphia, Pa.
Pittsburgh Machine & Supply Co.	Pittsburgh, Pa.
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Turley Gear & Machine Co.	St. Louis, Mo.
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Western Rawhide & Belting Co.
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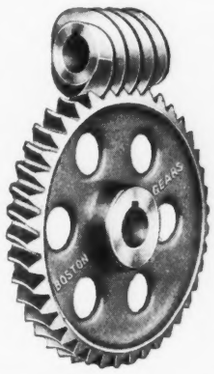
"Eliminate that Noise"

"Standardization Pays"

Scientifically Built Gears Increase Production and Lower Power Costs!

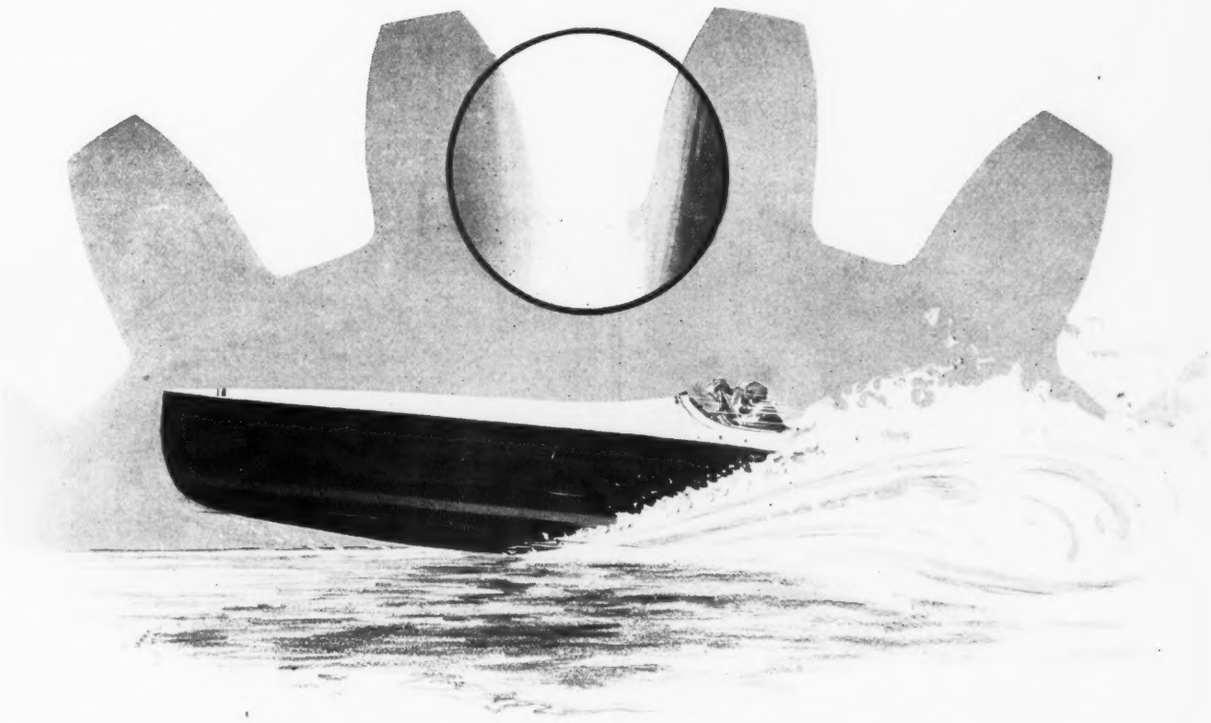


Worm gears—for right angle drives.

Scientific principles enter into the production of Boston Standardized Gears—that's why they take the chance out of power transmission. Think what it means to have *over 3000 sizes and styles ready for IMMEDIATE DELIVERY —anywhere.*

Use this coast to coast Gear Service—increase production —and *lower your costs for installation and upkeep.*

Write for new gear booklet—C3-26



—Specify 'Boston Standardized' for smooth running and long life.—

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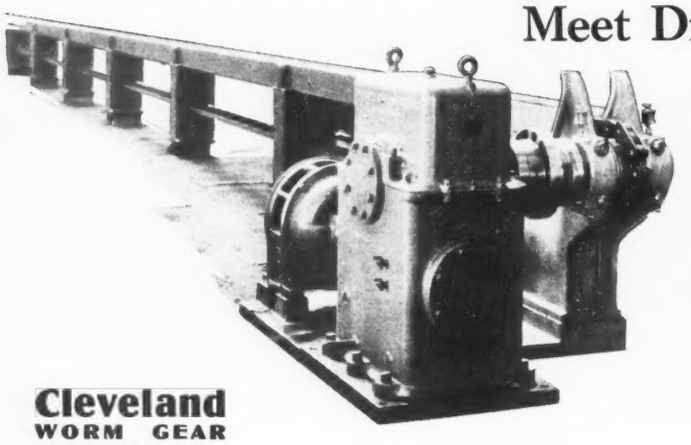
Standard Cleveland Worm Gear Reduction Units Meet Draw Bench Requirements



Cleveland
WORM GEAR
REDUCTION UNITS

This draw bench necessitates the use of a speed reduction unit that will transmit a steady flow of torque, quietly and efficiently. The Cleveland drive not only meets these requirements, but it also fits into the general design remarkably well. It saves space, reduces maintenance costs and eliminates production delays.

One of the largest tube and wire drawing companies in the East is using these benches. Each bench is 80 feet long and has a pulling capacity of 10,000 pounds.

Use the standard Cleveland reduction unit where durability and stamina count. They are made in a wide range of sizes and capacities.

Send us your power transmission problems

THE CLEVELAND WORM AND GEAR COMPANY
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Specified By Machine Designers

Cincinnati Gears

Experienced builders of high grade machinery know that the machine they build can be no better than its gears. Hundreds of manufacturers specify Cincinnati Gears because they have come to know them as a standard for uniformity of quality, and exactness to specifications.

We will be glad to estimate on your requirements—Send blue prints, drawings or samples.

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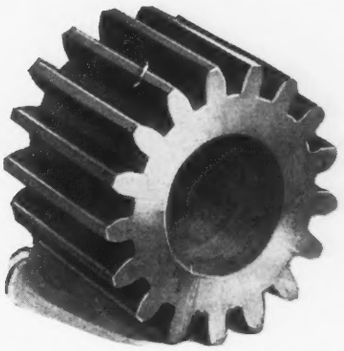
Philli Gear



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Manufacturers of Industrial Gears and Speed Reducing Units

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Chains, Sprockets, Racks, Ratchets and Pawls. Worm, Herringbone and Spur Gear SPEED REDUCTION UNITS.

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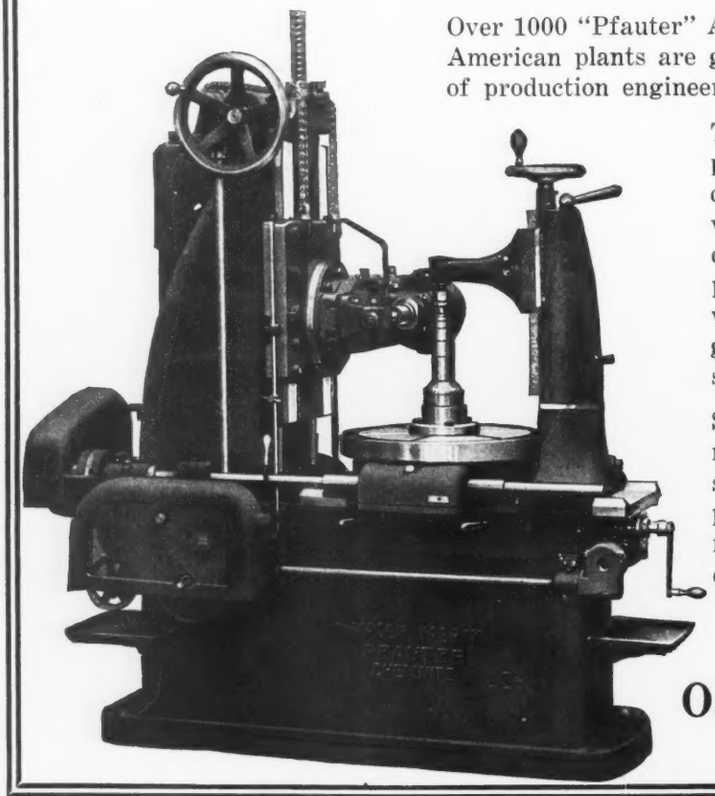
Pfauter Installations Make Good



Over 1000 "Pfauter" Automatic Gear Hobbers in well known American plants are giving service that meets the approval of production engineers.

The natural advantages of the hobbing process combined with "Pfauter" special features give simple operation and wide range; guarantee theoretically correct tooth form and rapid, accurate production of highest quality spur, worm, helical (spiral), herringbone gears, sprockets, ratchets, circular saws, spline shafts, etc.

Send for a circular on "Pfauter" Automatic Gear Hobbers, study the construction details—especially the simplicity of the mounting and supporting fixtures, etc. Sizes for gears to 157" diameter, 3/4 D.P.

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ALL METALS,
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Gears as large as this—larger—or small enough for fine precision machinery are "Earle" products. Our special facilities and exclusive methods insure gears exactly to your requirements, delivered when you want them and at the right price. Glad to estimate on your work.

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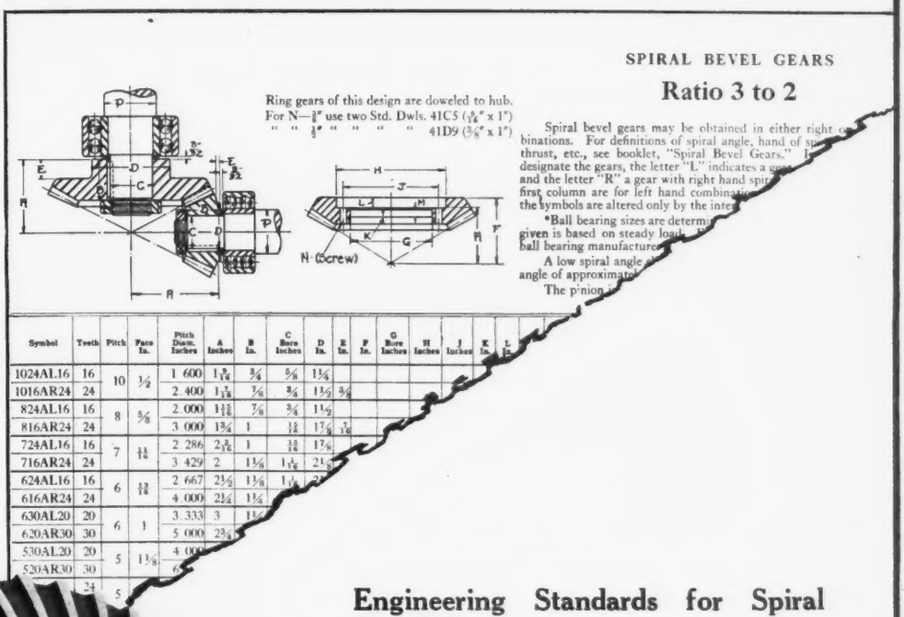
GLEASON

SPIRAL BEVEL GEARS



SPIRAL BEVEL GEARS

Ratio 3 to 2

Ring gears of this design are doweled to hub.
For N—$\frac{1}{4}$" use two Std. Dwls. 41C5 ($\frac{1}{4}$" x 1")
" " $\frac{1}{2}$" " " " " 41D9 ($\frac{3}{8}$" x 1")

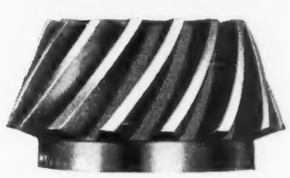
Spiral bevel gears may be obtained in either right or left hand combinations. For definitions of spiral angle, hand of spiral, thrust, etc., see booklet, "Spiral Bevel Gears." In this table the letter "L" indicates a gear with left hand spiral and the letter "R" a gear with right hand spiral. The gears in the first column are for left hand combinations. For right hand combinations the symbols are altered only by the interchange of the letters L and R.

*Ball bearing sizes are determined by the load capacity. The load given is based on steady load conditions and is the maximum for ball bearing manufacture.

A low spiral angle and a high spiral angle are provided for each angle of approximately 45 degrees.

The pinion

Symbol	Teeth	Pitch	Face In.	Pitch Diam. Inches	A Inches	B In.	C Bore Inches	D In.	E In.	F In.	G Bore Inches	H Inches	J Inches	K In.	L In.
1024AL16	16	10	1/2	1.600	1 3/16	3/4	5/8	1 3/4							
1016AR24	24			2.400	1 7/8	7/8	3/4	1 3/4	3/4						
824AL16	16	8	5/8	2.000	1 1/16	7/8	3/4	1 1/2							
816AR24	24			3.000	1 3/4	1	1 1/8	1 7/8	7/8						
724AL16	16	7	11/16	2.286	2 1/16	1	1 1/8	1 7/8							
716AR24	24			3.429	2	1 1/16	1 1/8	2 1/8							
624AL16	16	6	3/4	2.667	2 1/2	1 1/16	1 1/8								
616AR24	24			4.000	2 1/4	1 1/4									
630AL20	20	6	1	3.333	3	1 1/4									
620AR30	30			5.000	2 3/4										
530AL20	20	5	1 1/8	4.000											
520AR30	30			6											
	24	5													



Engineering Standards for Spiral Bevel Gears.

Our Standard sheets may be used by designers in making new machines and gear trains.

Each pair of gears on these standard sheets has the best possible design when considered from a standpoint of tooth form and section, and face length. Different types of housings and mountings are shown. The sheets also show the sizes for horse power to be transmitted. Ball bearing and taper roller manufacturers have contributed toward making these standards complete.

We will be very glad to furnish copies of these standard sheets to those who are interested.

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Manufacturers of Gears and Gear Cutting Machinery for Over 60 Years

G-E Fabroil Gears

48 Hour Delivery Service by "PITTSBURGH GEAR"

We are distributors of General Electric "Fabroil Gears," carrying in stock at Pittsburgh a large and carefully selected stock of rough blanks suitable for making almost every possible combination of teeth, pitch, face width and bore. Fabroil gear orders are put through a special routine which enables us to maintain the standard delivery service of 48 hours on motor pinions that we adopted ten years ago.

Fabroil has always been the strongest, most quiet running and most flexible non-metallic gear material on the market, and now that quick delivery service is available there is no reason why any manufacturer should use weaker and less efficient substitutes.

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As small gear specialists—our unusual facilities enable us to produce gears, both standard and special, in any quantity.

The accuracy of M-C gears—their moderate price—and good service have made M-C gears' satisfied users—the world over.

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SPEED REDUCING UNITS

Up to 5 H. P. Capacity

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GEAR HOBBERS

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BEVEL GEAR GENERATORS
All Types of Gears, also
SKEW BEVEL GEARS

Special facilities for *straight* and *spiraloid* Bevel Gears

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FOR EVERY INDUSTRIAL USE

—from the smallest motor pinion to the largest mill gear.

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More than 140 modern gear cutting machines in 75,000 sq. ft. of floor space in addition to the experience covering every known type of industrial gearing, make this possible. The next time you are thinking of gears, let us figure with you.

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Gear makers since '89

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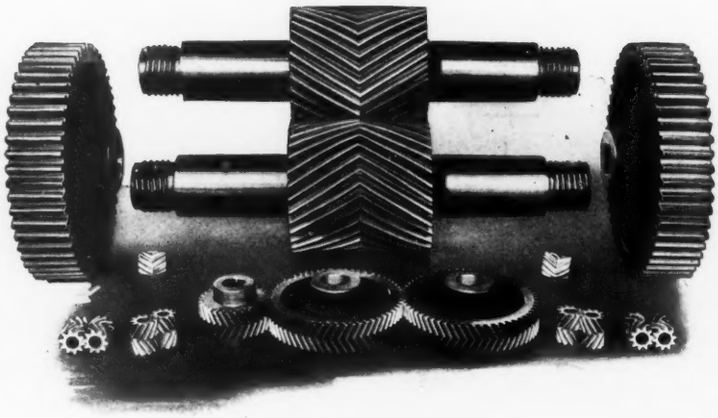
Gears for Every Industrial Purpose—Worm—Bevel—Herringbone—Spur Spiral—Hardened Heat Treated Gears—Non-metallic Gears and Pinions

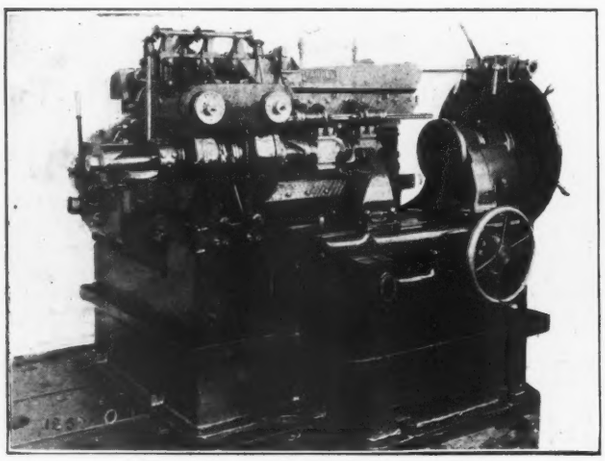
Favored by Manufacturers of Gear Reducers

Sykes Gear Generators reduce gear cutting costs to a new low level; Sykes Generated Gears set a new high standard for efficient gear service.

Lower production costs for better gears find the ready approval of manufacturers and users of gear reduction units and Farrel installations are increasing daily in these plants.



"The Gear with a Backbone"



Saves money on machine production and operation. Continuous tooth design enables Herringbone Gears to transmit more power than gap type gears almost one quarter wider.

The cut shows the No. 1-½ Gear Generator. Capacity ¼ inch to 18 inches diameter, ½ inch to 8 inch face. Cuts all types herringbones, helicals and spurs. Sykes Gear Generators may be had for gears from 1 inch to 18 feet in diameter.

Send for details of Farrel-Sykes Gear Generator.

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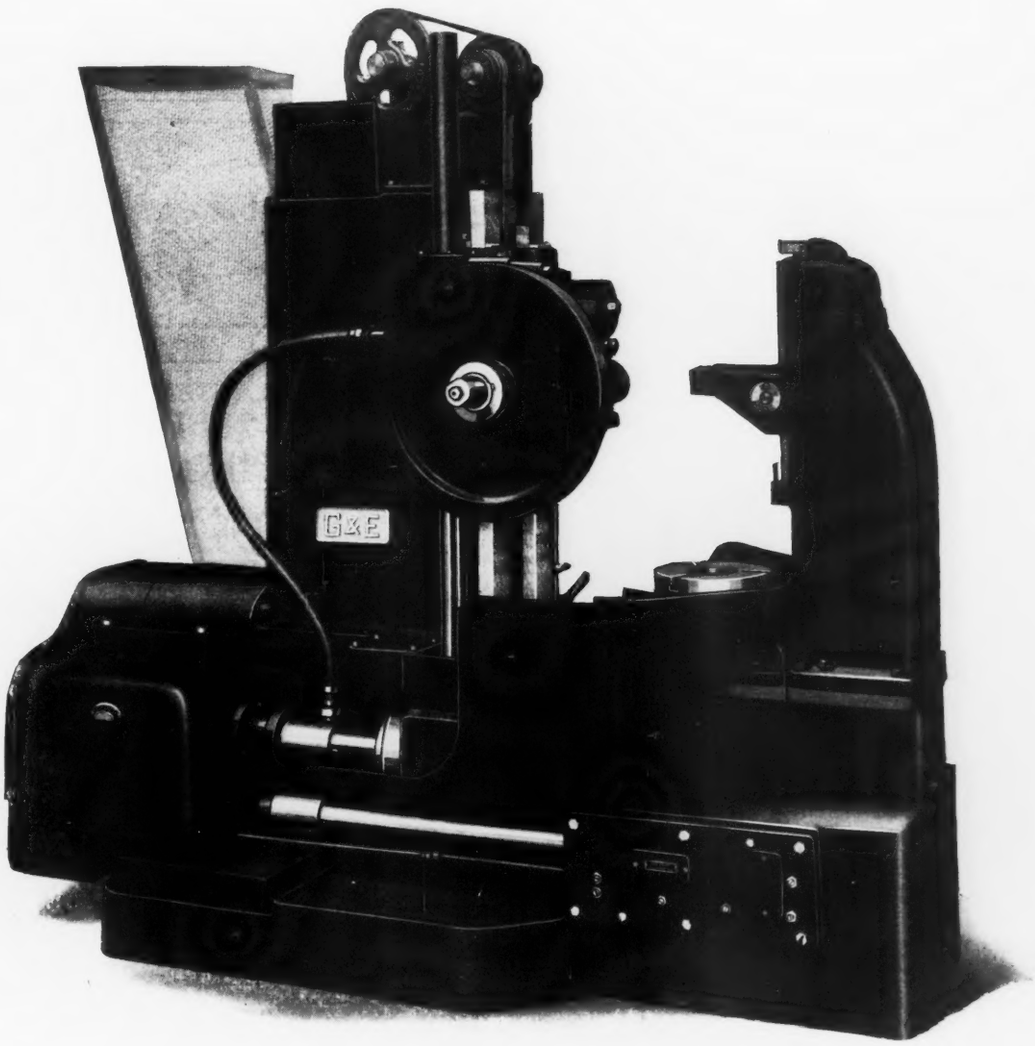

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One customer, using three of these machines on a wide range of spur-gear work, says that they have paid for themselves in six months.

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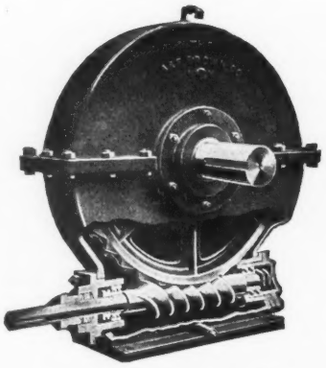
The worm and worm wheel is a very old speed reducing device and as formerly made only adaptable to light loads and slow speeds.

The long-lead multiple thread worm and corresponding wheel as more lately developed has overcome the objection to this form of speed reducer, and so increased its efficiency that it is now recognized as a most economical method of reducing speed with a minimum loss of power. *Noiseless, No Vibration, Durability, Safety.*

Spur Gear Speed Reducers, Change Speed Gears, Bevel Gear Transmission in Oil Tight, Dust Proof Cases.



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Planed Bevel Gears up to 48 in. diam.

Cut Spur Gears up to 96 in. diam.

Machine Moulded up to 192 in. diam.

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Stahl Gears are worthy of the machine you build.

Metal gears—spurs up to 72" dia., 1¼" D.P.; bevels up to 54" dia., 1¼" D.P.; spirals and herringbone gears up to 19" dia., 3 D.P.; worm gears up to 18" dia., 3 D.P.; racks 8' long; 3 D.P. Rawhide gears any requirement up to 15" dia., 2 D.P. We also manufacture Formica Pinions.

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Afford absolute protection against all belt accidents.

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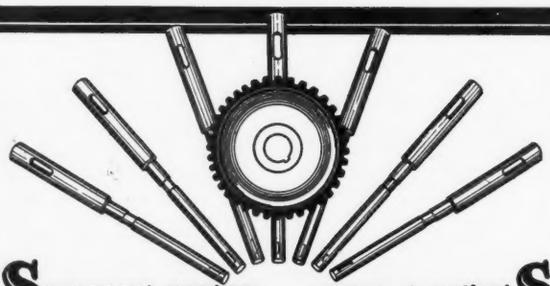

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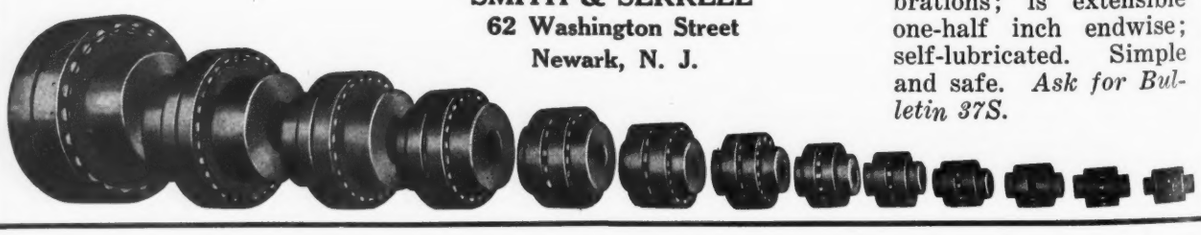
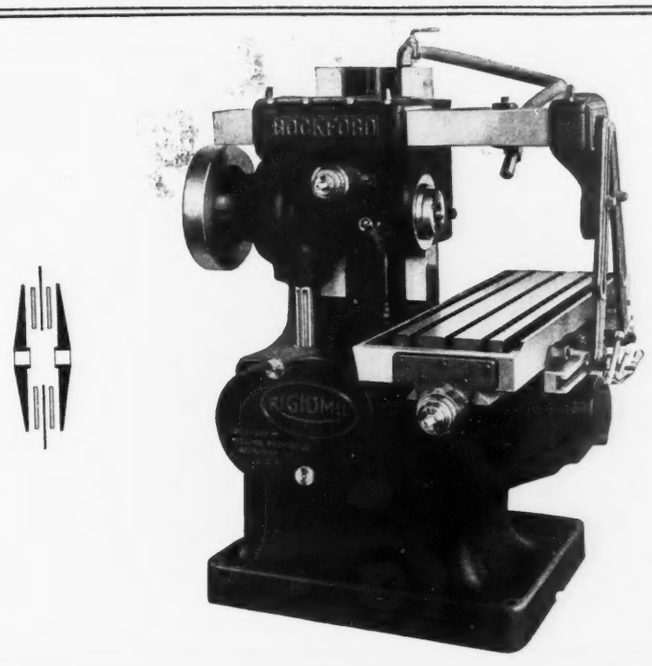
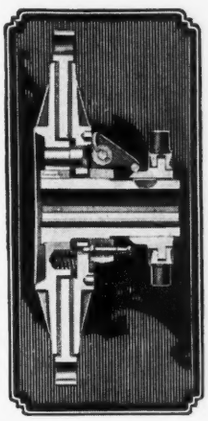




Rockford Rigidmil with Twin Disc clutch drive. Photo by courtesy of the Rockford Milling Machine Company, Rockford, Ill.



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The Price Is Attractive

WHEREVER machine tool engineering requires a clutch with smooth engagement under load; immediate, complete release at will; fine, accurate adjustment quickly and easily made; economy of space; minimum upkeep expense and continuous faithful service—*all* these advantages can be secured, at a conservative price, by the use of Twin Disc clutches.

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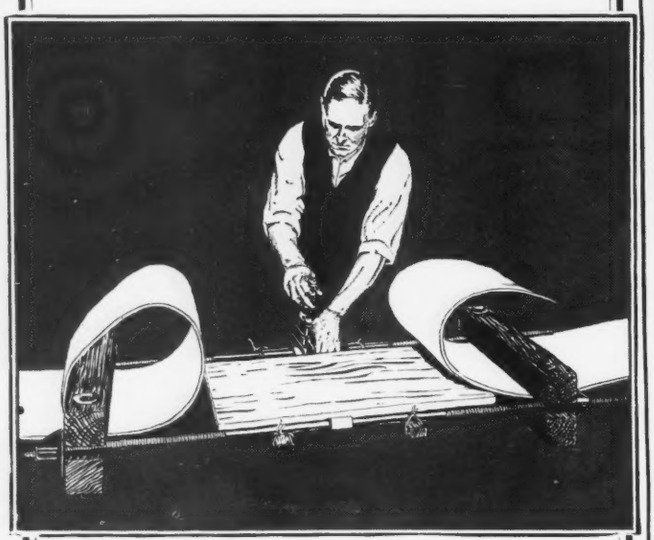
Too much time cannot be spent in removing the stretch, which usually amounts to about 1/4 inch to the running foot. This point is most important for the proper installation of the endless belt.



You really owe something to a good belt

You can double the life of a good belt if it is installed properly. With the aid of this new booklet, "There's money in this for You", you can prolong the life of your good belts indefinitely.

Your men can follow these simple instructions and keep all your belts in perfect repair. And the work will be done just as Schieren workmen do it.

We'll be glad to send you this booklet free of all obligations. All we ask is that you lend an ear to our story the next time you need a good belt.

X-BA BELTING TRADE MARK

Chas. A. Schieren Company ESTABLISHED 1868

TANNERS
BELT MANUFACTURERS
73 FERRY STREET, NEW YORK

CHAS. A. SCHIEREN COMPANY,
73 Ferry Street, New York.

Gentlemen:—

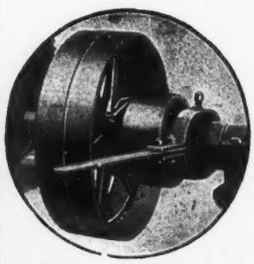
Please send me a copy of your booklet entitled, "There's Money in this for You".

Company .....

Address .....

Individual .....

Brown "Mule Pull" Clutches



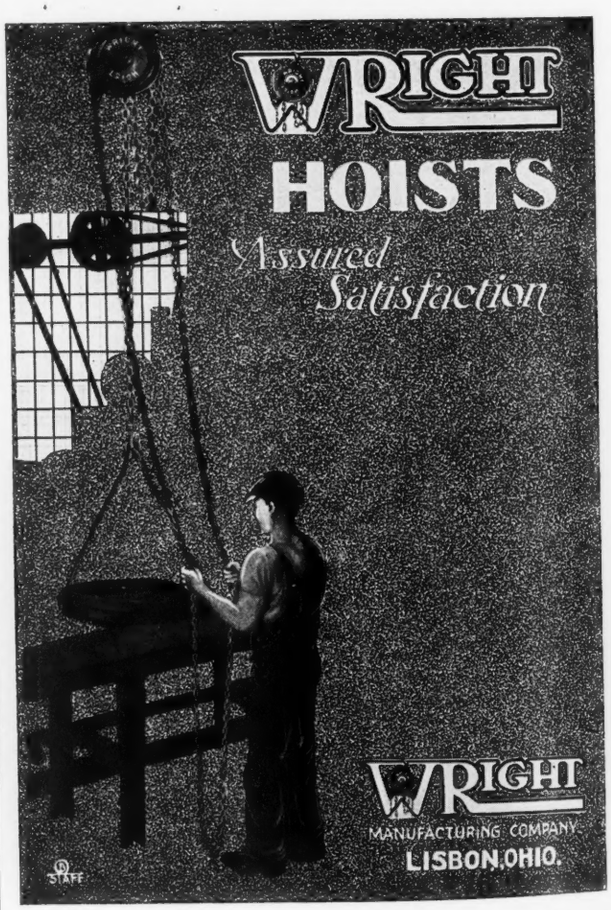
They Last and Last!

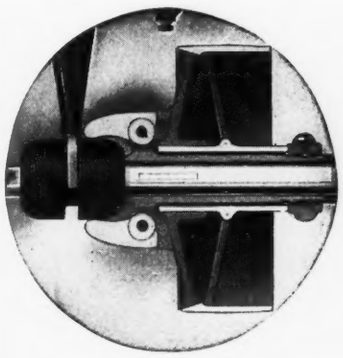
Brown "Mule Pull" Clutches engage and release smoothly and quickly, they do not waste power through slipping, they require practically no attention, and they last, seemingly, forever!

Some of the unusual features that make them so satisfactory are: Inside oiling groove on shifter collar which retains the lubricant so that it will outlast several of the ordinary type. The friction shoes are asbestos lagged, will not burn out on the fastest drives, and can be resurfaced easily and cheaply. Pressure is applied by rolling leverage, a method giving extremely powerful action and long life.

"Mule Pull" Clutches, true to their name, pull like well trained mules—the heavier the work, the harder they pull. Illustrated circular sent on request.

BROWN ENGINEERING CO.
133 North Third Street
READING, PA.





BARDONS & OLIVER FRICTION PULLEYS *for* COUNTERSHAFTS

Carried in Stock, Boxed Ready to Ship

We carry in stock the six sizes of friction pulleys listed—all boxed and ready to ship. When you need quick service telegraph us—your order will go forward immediately. We build complete countershafts also—let us quote prices.

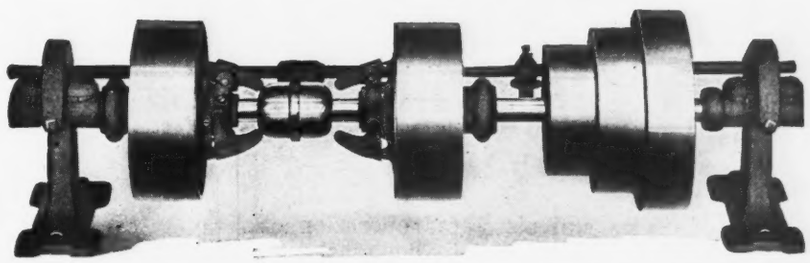
Pulleys in Six Sizes

9" x 2¾"	For 1⅜"	Shaft
10" x 3¾"	For 1½"	Shaft
12" x 4⅜"	For 1⅝"	Shaft
14" x 4⅞"	For 1¾"	Shaft
16" x 5⅞"	For 2 "	Shaft
18" x 5⅞"	For 2⅛"	Shaft

Send for the Circular

BARDONS & OLIVER

of Cleveland, Ohio



$53.00

Buys a One Ton HOIST

Hanna Engineering Works
1763 Elston Avenue CHICAGO, ILL.

ROEPER

ELECTRIC AND HAND POWER
TRAVELING CRANES
MONO-RAIL HOISTS
TROLLEYS
ROEPER CRANE & HOIST WORKS
READING, PA.

TRIBLOC CHAIN HOIST

Put it on wheels!

The kind of wheels that roll on overhead rails—for this method saves more than the mere cost of labor.

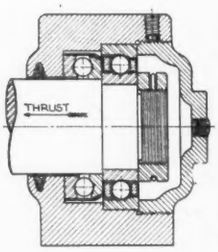
Tribloc Chain Hoists fitted to Ford Roller Bearing Trolleys provide quick, low-cost load-moving service for individual machines—we shall be glad to tell you why and how.

Send for Catalog 7-B

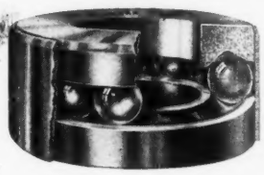
FORD CHAIN BLOCK CO.
2nd & Diamond Sts.
Philadelphia, Pa.

AUBURNS answer BEARING PROBLEMS

Auburn Ball Bearings overcome bearing troubles, reduce wear and tear, help avoid shut-downs for repairs. Write for list of sizes.



Special bearings made to inch or metric dimensions in small lots or quantities to answer your difficulties. Send particulars of your problem.



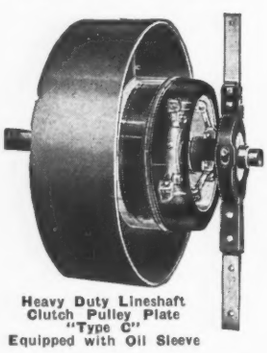
Steel, Brass and Bronze Balls

AUBURN BALL BEARING CO., Trade Mark Established 1893 **33 Elizabeth St., Rochester, N. Y.**

Edgemont Clutches
Effect Big Savings

Wherever Edgemont Clutches are installed immediate savings on power, pulley and machine wear and maintenance are readily noticeable. Located at the individual machines or on lineshafts, they save tremendously by limiting the power only to active units.

Edgemont Clutches are made in a wide variety of styles and sizes, for operation on heavy line shafts down to drives for single small machines.

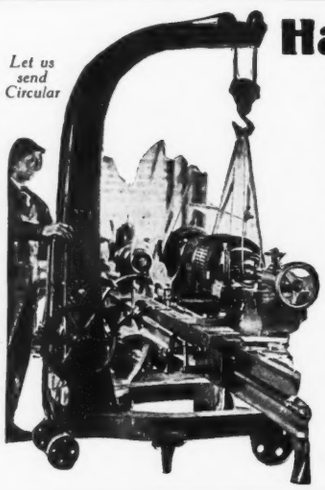


Heavy Duty Lineshaft Clutch Pulley Plate "Type C" Equipped with Oil Sleeve

May we send complete details?

Edgemont Clutches
Clutch Pulleys
Cut-Off Couplings
Extended Sleeve Clutches and Special Clutches for all Purposes—described in Catalog "G".

The Edgemont Machine Co.
2700 National Avenue DAYTON, OHIO, U. S. A.



Let us send Circular

Handy Lifting

With the Canton Portable Crane one man can safely swing parts and machinery up to 6000 pounds dead weight right where wanted. Goes anywhere—base low enough to fit under lathes, etc. New Safety Friction Load Brake holds the load securely at any point. These handy cranes save hours of profitable production time all over the plant.

New Safety Friction Load Brake can be installed on Canton Cranes already in service.

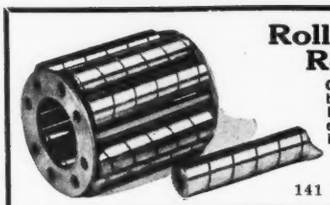
Canton Foundry & Machine Co.
CANTON, OHIO
New York Office, 203 E. 15th St.

ROLLER THRUST BEARINGS

STANDARD DIMENSIONS
or to ORDER, up to 12" Shaft Dia.

One—or one thousand

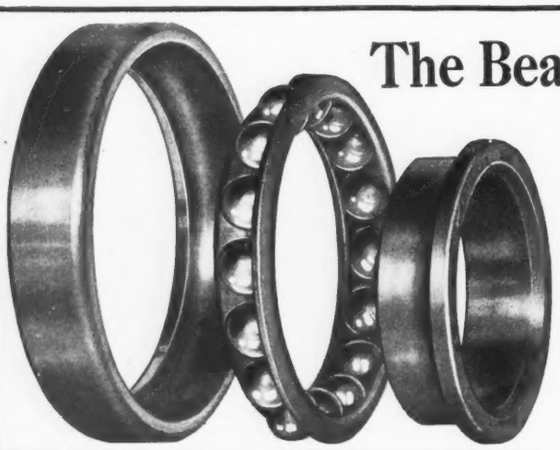
The Gwilliam Company
23 Flatbush Ave., Brooklyn, N. Y.



Rollers—or Complete Roller Bearings

Complete flexible or solid type roller bearings, or rollers only—any size. Replace your plain bearings or rollers with our "anti-friction" bearings. Write for details.

Roller Bearing Co. of America
141 Frelinghuysen Ave., Newark, N. J.

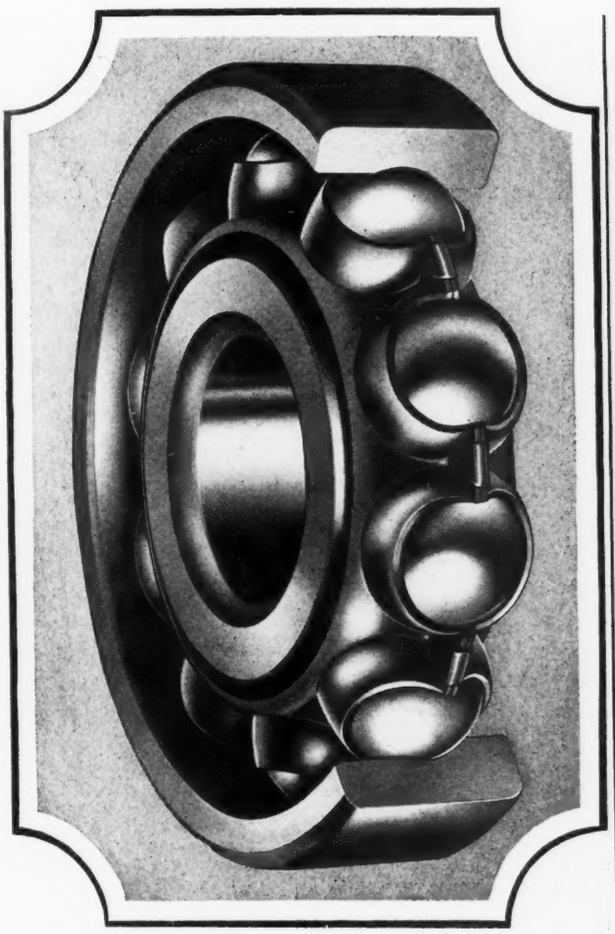


The Bearings Company of America
LANCASTER, PENNA.

Angular Contact Radial Bearings.
Angular Contact Thrust Bearings.
Thrust Ball Bearings.
"STAR" Ball Retainers for Thrust, Magneto, and Cup and Cone Bearings.

Your Inquiries Are Solicited

Western Sales Office, 1012 Ford Bldg., Detroit, Mich.



Molybdenum Steel Balls

for Severe Load Requirements

For more than twenty years the name Gurney has stood for the Maximum in Load Carrying Capacity. This is made possible by using the maximum number of balls of the maximum size in uninterrupted raceways of the closest permissible curvature.

Molybdenum Steel Balls, now used in all Gurney bearings, increase the capacity even further. A comparison of load ratings will prove these statements.

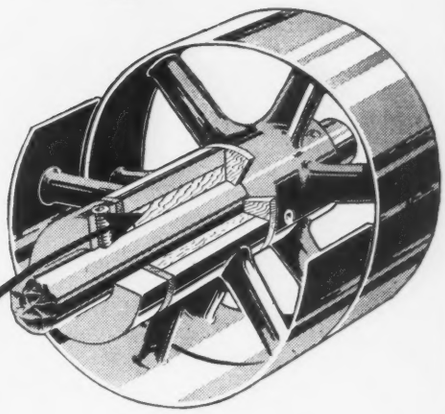
Send for new Data Sheets —just out.

MARLIN-ROCKWELL CORPORATION
Gurney Ball Bearing Division
JAMESTOWN, N. Y.

18354

GURNEY BALL BEARINGS

Arguto



The Bearing which says "No" to time —

At one-tenth the cost and with over six times the life of the best bronze, you can equip your countershafts with Arguto Oilless Bushings and Bearings.

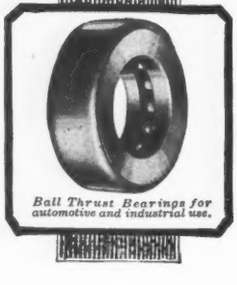
ARGUTO OILLESS BEARING CO.
WAYNE JUNCTION, PHILADELPHIA

PENNY SHAVING – *a costly practice in buying metal balls*

THE price spread between a quality steel ball and a ball of inferior quality is measured in fractions of a cent. An altogether trifling difference. A difference that fades into insignificance when compared with the *plus value* delivered by quality steel balls.

This *plus value* is expressed in definite, certain terms. It is low cost protection against the failure of your product in service. It is an effective preserver of the goodwill and reputation your product enjoys for fine performance. It is a magnet that attracts new business and new customers. It is an insurance policy that gives your product a better chance in today's keen competition.

Ball Retainers for Thrust Bearings and Cup and Cone Bearings.



Ball Thrust Bearings for automotive and industrial use.

Hoover Metal Balls are built to a rigid standard that insures 100% value to the buyer. Thousands of dollars worth of special laboratory equipment for testing raw materials and finished work protect the quality of Hoover Metal Balls. And back of every ball produced by Hoover are the resources and reputation of the largest manufacturer of metal balls in the world.

HOOVER STEEL BALL CO., *Ann Arbor, Mich.*

Branch Offices:

CHICAGO
1901 Mallers Bldg.

DETROIT
General Motors Bldg.

PHILADELPHIA
Liberty Trust Bldg.

HOOVER

CHROME MOLYBDENUM *and* METAL BALLS

Steel · Brass · Aluminum · Bronze Monel Metal · Stainless Steel

Tapered Roller Bearings made to customer's blueprint for automotive and industrial use.

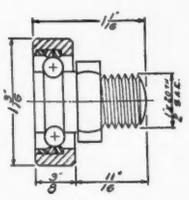
Hoover Steel Ball for all types of bearings.

Commercial

PUT "Commercial" Annular Ball Bearings in your product or machines and increase bearing efficiency while you lower bearing costs. Adaptable to a wide variety of uses. Capable of sustaining a thrust load equivalent to 50% of radial load. In addition to this feature, "Commercial" Annular Ball Bearings will simultaneously sustain radial and thrust loads. The ability to render unusual service of this character is due to *the famous 3-area contact.*

Commercial
ANNULAR BALL BEARINGS

A TYPICAL INSTALLATION



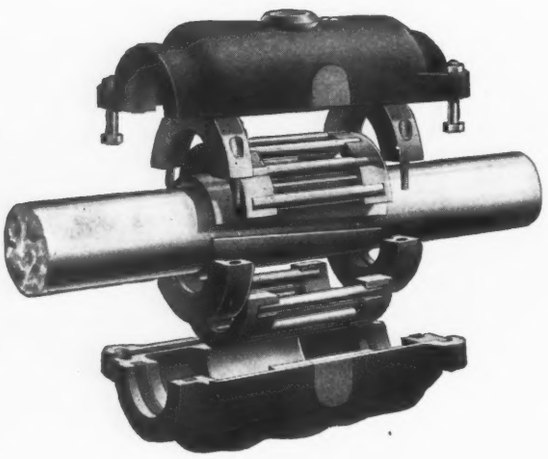
Stud Roller No. CS-700 is used for carrying passenger elevator doors. The design shown is one of many rollers for this service, differing in details and dimensions.

Send for Illustrated Catalog, Discount Sheets and Samples.

THE SCHATZ MANUFACTURING COMPANY, Poughkeepsie, New York

Better Design *Better Service*

Today—Plain Babbitt—
Tomorrow—"Sells" Roller Bearings



A Roller Bearing that will go in most places where a plain Babbitt Bearing comes out—that's the "Sells".

"Sells" Roller Bearings can be installed on your line shaft over night, without disturbing any of the present line shaft attachments. All members of these easy-to-fit Roller Bearings are split, and size for size they will go into 95% of all modern frames.

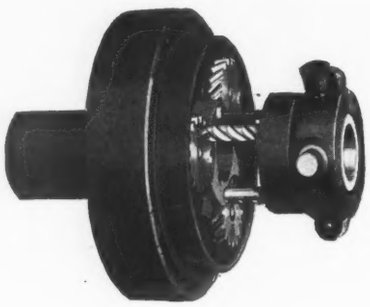
Even though the shaft is worn or scored, the steel split sleeve—which is a patented feature of the Sells Bearing—will take care of this condition, affording a better bearing surface for the rollers.

Aren't those good reasons for wanting to know more about "Sells" Bearings? We'll gladly send Bulletin "J" giving details and prices.

A little folder "Advantages" is full of them —for you. Shall we send it?

Royersford Foundry & Machine Co., 54 Main St., Royersford, Pa.

The ROYERSFORD LINE



HILLIARD FRICTION CLUTCH SERVICE

Twenty years of experience has taught us that it is almost impossible to design a clutch that will be equally efficient on a wide range of applications. To insure the most economical operation, clutches, like machines, must be particularly adapted to the work they are intended to do.

Hilliard engineers will gladly aid you in designing clutches to meet your individual requirements, where one or more factors differ from the usual.

Let us tell you about some of the special installations of Hilliard Friction Clutches or about the Hilliard line of standard clutches.

THE HILLIARD CORPORATION
ELMIRA, N. Y.

FALLS

Worldwide Satisfaction

Day in and day out, in thousands of plants throughout the world, Falls Transmission Machinery is rendering efficient, lasting, trouble-free service. Thus it maintains the Falls reputation of superiority in design, construction and performance.

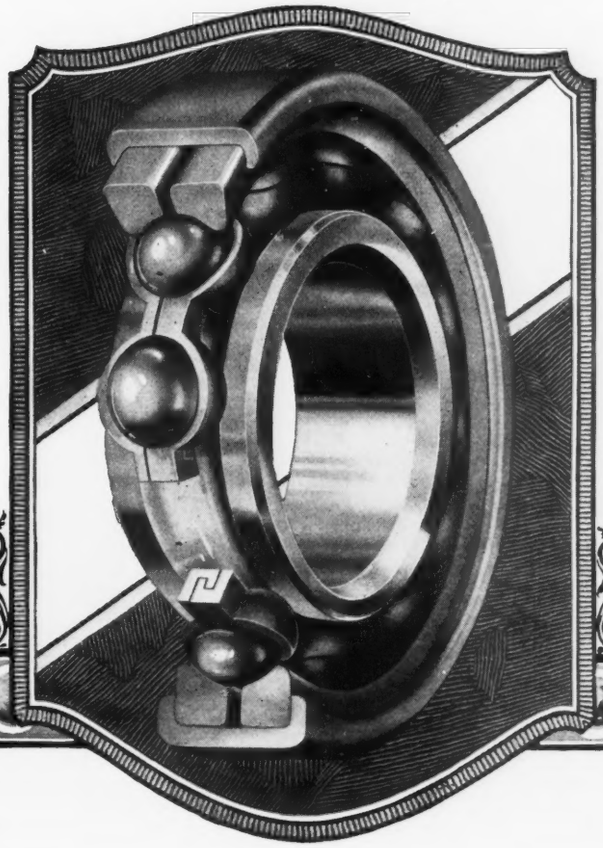
Presenting a complete line of correctly designed, honestly built and consistently priced transmission machinery, Falls is indeed the logical source of supply for equipment of this kind.

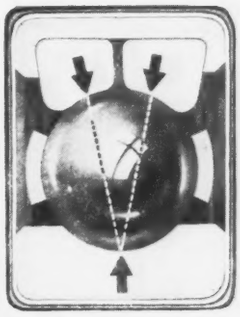
Prove this to your own satisfaction by sending for Handbook 18-G today.

The Falls Engineering Service is at your disposal. Feel free to use it whenever the occasion requires.

THE FALLS CLUTCH & MACHINERY CO.
Kent, Ohio
New York: 206-208 Fulton St.
Boston, Mass. 52-58 Purchase St.

The Mark of Quality





The famous 3-area contact

A Notable Achievement In Bearing Design

The 3-area contact is the outstanding feature of Schatz "Universal" Annular Ball Bearings. This notable achievement in design gives to "Universal" unusual adaptability. Sudden and heavy radial thrusts in no way reduce efficiency. Schatz "Universal" bearings are preferred because they give longer and better bearing service under any and all conditions.

THE FEDERAL BEARINGS CO., INC.

Poughkeepsie New York

Schatz "UNIVERSAL" Registered U.S.Pat.Off. *Annular* **BALL BEARING**

What About Other Plants In Your Industry?

REEVES PULLEY COMPANY
SOLE MANUFACTURERS OF — INCORPORATED 1888

REEVES
VARIABLE SPEED TRANSMISSION · WOOD SPLIT PULLEY
MOTOR PULLEY · WOOD SPLIT PULLEY CLUTCH
POWER TRANSMISSION APPLIANCES

COLUMBUS, IND., U.S.A.

Dear Sir:

If you were to take an inspection trip through some of the other up-to-date plants in your industry, doubtless you could pick up many useful ideas. Others could do the same in going through your plant. These ideas and methods would be valuable because they had proved their worth in actual operation. You might be able to adopt or adapt them in your own plant with profit.

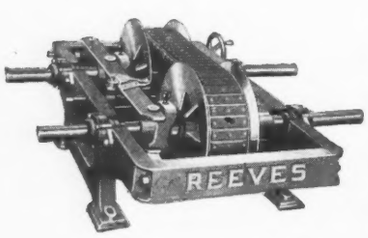
One of the most generally useful devices you would encounter would be the REEVES Variable Speed Transmission. Progressive manufacturers everywhere, in almost every line of industry, have adopted this simple, inexpensive device as the one truly accurate and dependable method of giving speed variation to their production machines and conveyors.

The REEVES Transmission has a universal use, because it is so easily and conveniently applied to any kind of machine.

Modern production methods demand accurate speed control. And with the REEVES Transmission you can get any speed at any time, on any machine. The REEVES gives your machines and conveyors the speed flexibility of an automobile -- it regulates your machines as quickly and easily as the accelerator controls your motor car.

Find out about the uses of the REEVES Transmission in your industry. Let us tell you how REEVES Transmissions have proved profitable for your own fellow manufacturers.

Yours very truly,
REEVES PULLEY COMPANY
By ——— President.

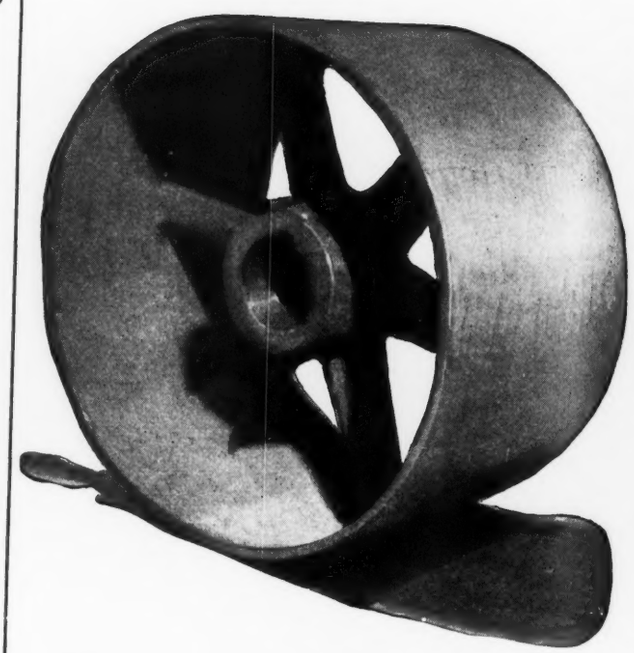


Our Catalog M-66 gives full information. Send for it!

The REEVES Transmission is a simple, compact, mechanical device which receives power at a constant speed and delivers it at any speed desired to any machine or group. It will maintain one set speed indefinitely, or may be changed instantly to meet any different operating condition. Force-feed lubricated. Complete ball-bearing. Accurate and dependable always.

REEVES PULLEY COMPANY
Established 1887
Columbus, Indiana

REEVES
Variable Speed Transmission



When You Order Pulleys

Be sure, when you again need pulleys, to find out the service you can get from Jones.

In addition to cast iron pulleys that are skillfully molded, accurately balanced, and carefully machined, you get a source of supply that is dependable.

Our Catalogue No. 30 will show you how broad our service is and how reasonable our prices. Write for it.

W. A. Jones Foundry & Machine Co.

Main Offices and Works: 4409 West Roosevelt Road, Chicago
Branch Sales and Engineering Offices:
New York, Cleveland, Milwaukee, Pittsburgh, Buffalo, Detroit, Birmingham, St. Louis, Cincinnati
Pacific Coast Representatives:
The King-Knight Company, San Francisco, Los Angeles, Seattle

Jones Pulleys

BUNTING
PHOSPHOR BRONZE
BUSHING BEARINGS

24 HOUR SERVICE

YOU can get Bunting Bushing Bearings instantly in the six industrial centers of America.

Over 4,000,000 completely machined and finished Bushing Bearings, representing over 500 sizes, are constantly carried in stock.

Eighty sizes of Cored and Solid bars of Bunting Phosphor Bronze are carried in stock.

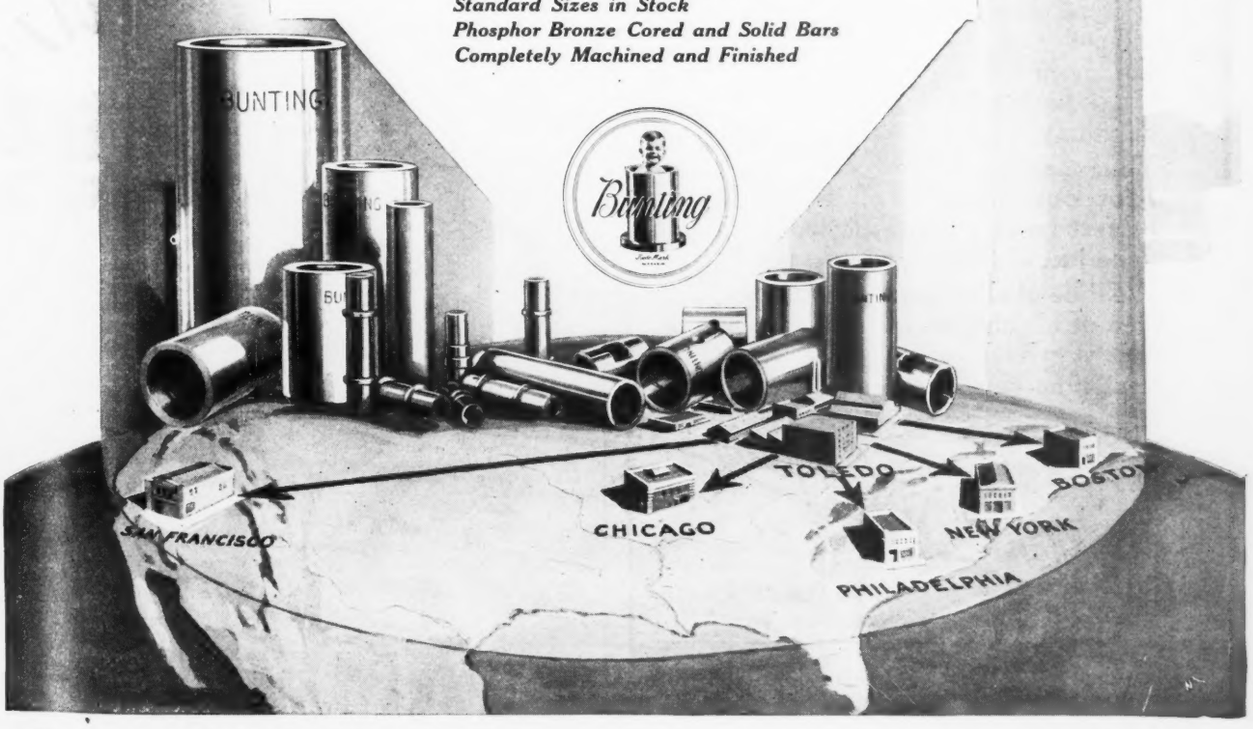
Special sizes made from your blue prints shipped promptly from our factory at Toledo.

Over 5,000 manufacturers in every industry are drawing their Bushing Bearing requirements as they need them, from one of these Bunting stocks.

Six warehouse stocks and sales offices are maintained at our expense for your convenience.

Are you taking advantage of this service?

Special Designs and Sizes
Standard Sizes in Stock
Phosphor Bronze Cored and Solid Bars
Completely Machined and Finished



THE BUNTING BRASS & BRONZE CO. **TOLEDO, OHIO**

Branches and Warehouses at

NEW YORK
245 West 54th St.
Columbus 7528

PHILADELPHIA
1330 Arch St.
Spruce 5296

BOSTON
36 Oliver St.
Main 8488

SAN FRANCISCO
198 Second St.
Douglas 6245

CHICAGO
2015 S. Michigan Ave.
Calumet 6850-6851

Enter the edge about 2½ inches back from the point so it can be gradually opened without tearing.

You really owe something to a good belt

You can double the life of a good belt if it is installed properly. With the aid of this new booklet, "There's money in this for You", you can prolong the life of your good belts indefinitely.

Your men can follow these simple instructions and keep all your belts in perfect repair. And the work will be done just as Schieren workmen do it.

We'll be glad to send you this booklet free of all obligations. All we ask is that you lend an ear to our story the next time you need a good belt.

X-BAR BELTING TRADE MARK

Chas. A. Schieren Company ESTABLISHED 1868

Tanners
Belt Manufacturers
73 Ferry Street, New York

CHAS. A. SCHIEREN COMPANY,
73 Ferry Street, New York.
Gentlemen:—

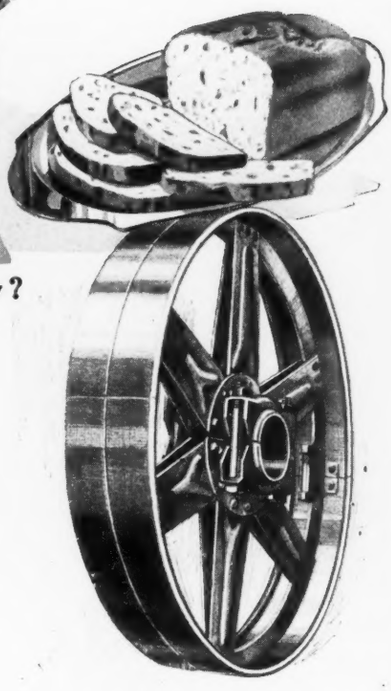
Please send me a copy of your booklet entitled, "There's Money in this for You".

Company .....

Address .....

Individual .....

Eventually



Why Not Now?

PATENTED

The "American" Pressed Steel Shaft Hanger, because of its great strength, its rigidity against vibration, its easy adjustment and its handsome appearance has become the standard hanger for many of the largest and most exacting uses of power transmission equipment.

NO SLOGAN is quoted more frequently. Yet it is not the slogan, but living up to what it implies that nas built up the prestige and demand for Gold Medal "Kitchen Tested" Flour.

It is difficult to conceive of a finer example of successful co-ordination of effort. Beginning with the experiment station, the seed grower and the farmer, it extends to millions of kitchens and dinner tables.

Midway in this path are the huge mills in which every item of mechanical equipment must be capable of keeping pace with a stupendous production built upon an absolute uniformity of quality and texture.

Whatever bettered the product or improved production has always been adopted and kept.

Years ago "AMERICAN" STEEL SPLIT BELT PULLEYS were adopted by the Washburn-Crosby Company because of their accuracy, their strength, their lightness which imposed no excess load on the power line, and their ability to grip the belt tightly and transmit power efficiently.

Today there are thousands of "AMERICANS" engaged in milling Gold Medal Flour.

Nearly 400 mill supply dealers carry them in stock for prompt service. The name, address and telephone number of these dealers are listed in MacRae's Blue Book.

The American Pulley Co.

Manufacturers of Steel Split Transmission Pulleys, Pressed Steel Shaft Hangers, Pressed Steel Hand Trucks and Pressed Steel Shapes

4200 Wissahickon Ave., Philadelphia, Pa.

AMERICAN
PRESSED STEEL HANGERS PATENTED | STEEL SPLIT PULLEYS PATENTED

All chains look alike externally—b-u-t—

***Look Deeper*—taken apart they are quite different. There is only one Link-Belt Silent Chain and this is its construction.**

THIS smooth hardened round pin rotates between two semi-circular hardened steel bushings—prevents wear, adds years of life to the drive, and can be renewed after long service.

Drives from less than 1 H. P. to hundreds of H. P. in service five, ten and twenty years.

Send for Data Book No. 125. Drives from ½ to 10 H. P. carried in stock everywhere.

LINK-BELT COMPANY 2723

PHILADELPHIA, 2045 Hunting Park Ave.

CHICAGO, 300 W. Pershing Road INDIANAPOLIS, P. O. Box 85

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V.P. Dalmas & Co., 100 W. Winchester Ave.
Atlanta, 610 Citizens & Southern Bank Bldg.
Birmingham, Ala. - 720 Brown-Marx Bldg.
Boston - - - - - - - - 49 Federal St.
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J. S. Cothran, 909 Com'l Bank Bldg.
Cleveland - - - - - - - 531 Rockefeller Bldg.
Denver - - - - - - - 520 Boston Bldg.
Detroit - - - - - - 5938 Linsdale Ave.
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Kansas City, Mo., R.436,1002 Baltimore Ave.
Louisville, Ky. - - - - - 321 Starks Bldg.
Milwaukee, - Room 1403 - 425 E. Water St.
Minneapolis, Minn. - - - - - - - -
Link-Belt Supply Co., 418 S. Third St.
New Orleans 504 New Orleans Bank Bldg.
New Orleans - - - - - - - - - -
Whitney Sup. Co. Ltd., 733 Tchoupitoulas St.
New York - - - - 2676 Woolworth Bldg.
Pittsburgh - - - - - - - 335 Fifth Ave.
St. Louis - - - - - - - 3638 Olive St.
Wilkes-Barre - 826 Second Nat'l Bank Bldg.

LINK-BELT LIMITED—Montreal, 10 Gauvin Lane; Toronto 2, Wellington and Peter Sts.

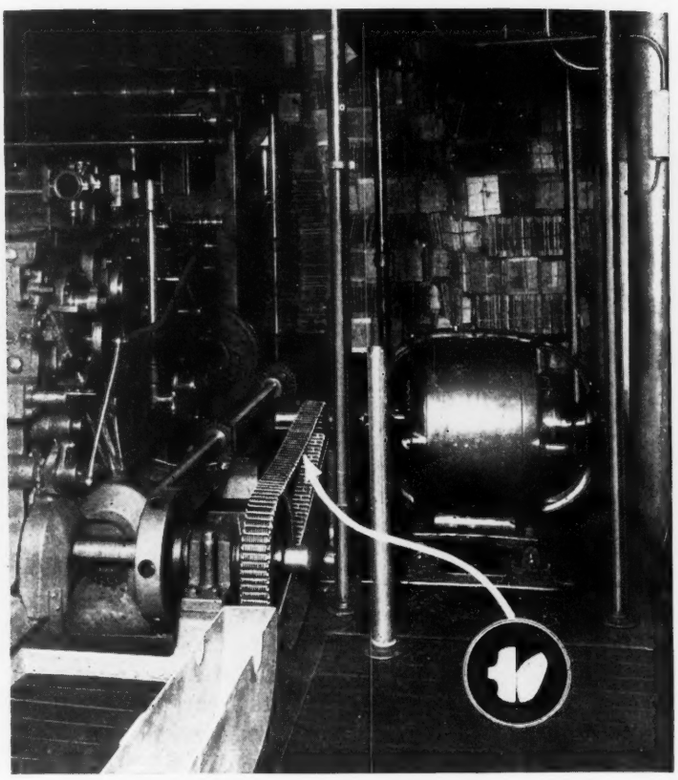
H. W. CALDWELL & SON CO.:—Chicago, 1700 S. Western Ave.; Dallas, Texas, 810 Main St.; New York, 2676 Woolworth Bldg.

LINK-BELT MEESE & GOTTFRIED CO.:—Fresno, Calif., 215 Brix Bldg.; Los Angeles, 400 E. Third St.; Oakland, Calif., 526 Third St. Portland, Ore., 67 Front St.; San Francisco, 19th and Harrison Sts.; Seattle, 820 First Ave., S.

LINK-BELT

Efficient Silent Chain Drives

Morse Chains carry heavy, variable load 24 hours daily



Morse Silent Chain Drive from motor to high speed press, Jersey City Printing Co.

Machinery of every type can be profitably driven by Morse Silent Chains. Read the report from the Jersey City Printing Co., the largest producer of telephone directories in the country. Their average daily output for 8 months is 80,000 books.

"Two specially built high speed telephone book presses are driven by 25 h.p. 1200 r.p.m. motors, and operate 24 hours a day, 7 days a week, for 8 months of the year. Two years ago we installed two 3-in. Morse Silent Chains on 36-in. centers for the main drives of these presses, to replace direct gear drives. These chains were so satisfactory that we replaced gear drives on 2 additional presses, and plan to equip our 2 other presses and all future presses of this type with Morse Chains.

"The continuous service and frequent starting and stopping of the presses puts a tremendous load on the chains, but the Morses require only regular lubrication and inspection.

"The chains pay for themselves at least once a year, by eliminating forced shut-downs for repairs and insuring us against production delays."

Experienced Transmission Engineers are always at your service.

MORSE CHAIN CO., ITHACA, N. Y., U. S. A.

ATLANTA, GA.....702 Candler Bldg.
Earl F. Scott & Co.
BALTIMORE, MD.....1402 Lexington Bldg.
BIRMINGHAM, ALA..Moore-Handley Hdwe. Co.
BOSTON, MASS.....141 Milk St.
BUFFALO, N. Y.....Ellicott Square Bldg.
CHARLOTTE, N. C..404 Commercial Bank Bldg.
CHICAGO, ILL.....112 W. Adams St.
CLEVELAND, OHIO.....421 Engineers Bldg.
DENVER, COLO.....211 Ideal Bldg.
DETROIT, MICH.....7601 Central Ave.

LOUISVILLE, KY.....516 W. Main St.
E. D. Morton Co.
MINNEAPOLIS, MINN.....413 Third St.
Strong-Scott Mfg. Co.
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Queen & Crescent Bldg., 334 Camp St.
A. M. Lockett & Co., Ltd.

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OMAHA, NEB.....727 W. O. W. Bldg.
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PITTSBURGH, PA.....Westinghouse Bldg.
SAN FRANCISCO, CALIF.....Monadnock Bldg.
ST. LOUIS, MO...2137 Railway Exchange Bldg.
TORONTO 2, ONT., CAN....50 Front Street E.
Strong-Scott Mfg. Co.
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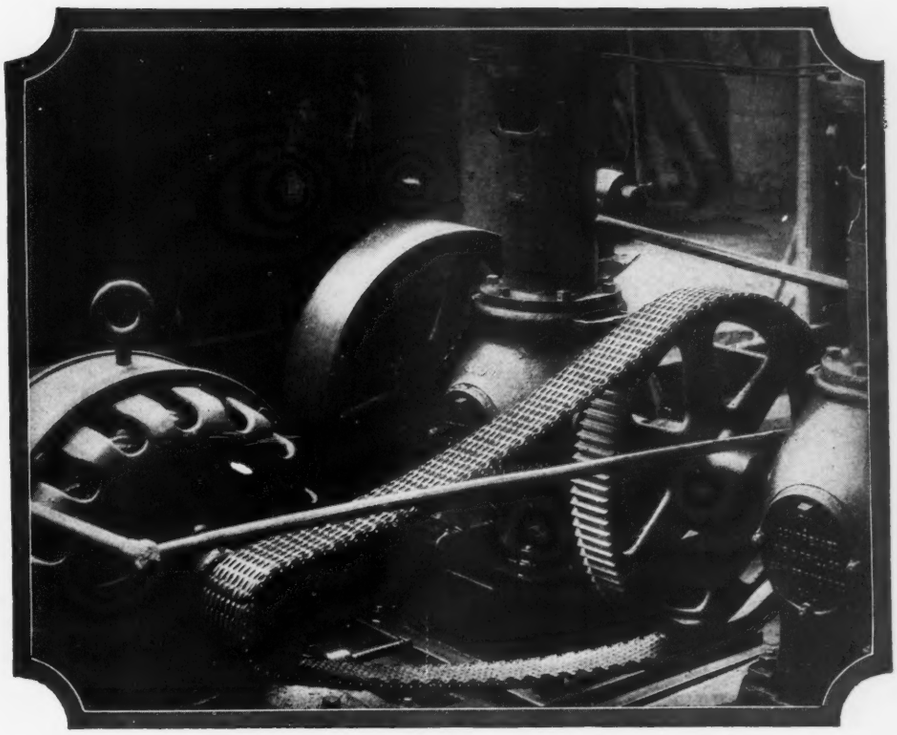
Strong-Scott Mfg. Co.

MORSE SILENT CHAIN DRIVES

THE MORSE "ROCKER JOINT"

Air compressor driven by "Whitney" Silent Chain.



You should specify the "Whitney" Silent Chain Drive because—

It requires little attention beyond proper lubrication.

It has a long life of noiseless service. The load is spread over an unusually large joint area, and the wear is therefore negligible.

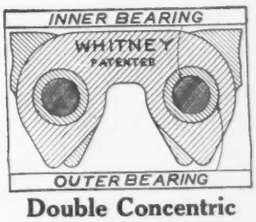
It is highly efficient—it cannot slip.

It is not injured by moisture or temperature.

It decreases bearing trouble by absorbing shock and by diminishing tension.

It adds definitely to the prestige of the machine it serves.

"WHITNEY"



Double Concentric Bearing Joint

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
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SOUTH HALL
373

Let our engineers fit the drive to the job

THE WHITNEY MFG. CO., Hartford, Conn.

SALES AND ENGINEERING OFFICES:

NEW YORK	BOSTON	PHILADELPHIA	SYRACUSE	CHICAGO
L. C. Biglow & Co., Inc. 250 W. 54th St.	The Whitney Mfg. Co. 727-A Boylston St.	The Whitney Mfg. Co. 1505 Race St.	George McPherson 201 Norwood Ave.	The Whitney Mfg. Co. 549 W. Washington Blvd.
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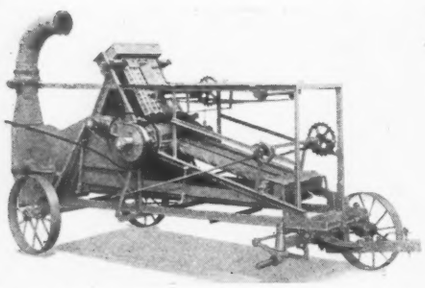
Pittsburgh Gear & Mach. Co. 27th & Smallman Sts.	Smith Power Transmission Co. 1218 Ontario St.	The Whitney Mfg. Co. 2-240 General Motors Bldg.	A. H. Coates Co. 615 Howard St.	A. H. Coates Co. 1115 East Union St.

CHAINS AND SPROCKETS FOR POWER TRANSMISSION



Husky!

The New Idea Spreader Company are using Conway Clutches on their Corn Huskers.

Enormous Leverage, full peripheral contact, one point handy adjustment, easy engagement, drag-free idling, are clutch features that command attention.

All these salient points of efficient starting and stopping, together with exceptional power capability, are embodied in the Conway Clutch.

Have you our bulletins Nos. 26 and 35?

The Conway Clutch Co.
Storrs Station
Cincinnati, Ohio

Lamp Guards

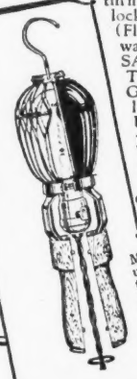
FLEXCO-LOK

Pay their way Day by Day

Day by day, year in and year out, they stand guard over your lamps. Theft, unauthorized removal, breakage with possible eye accidents, fire and other risks are minimized. Expanded steel reinforced, bright tin finish. No heavy shadows. Key locking (Flexco-Lok) or plain (Flexco) in range of sizes to warrant standardization. SAMPLE of 60 watt Regular Type guard furnished gladly. Give socket diameter and lamp length. Approved by Underwriters Laboratories.

Flexible Steel Lacing Co.
4622 Lexington St.
Chicago, U.S.A.

Regular type. All types made for standard brass and weather proof sockets.

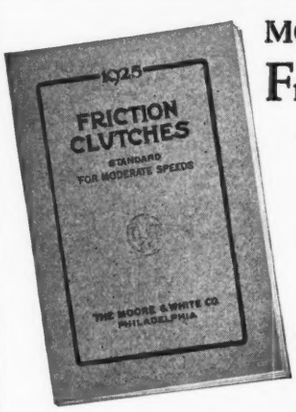


Made from Regular or Reflector types. No split handles and handle lock.

Reflector type.

For mill type and small lamps.

FLEXCO



MOORE & WHITE

Friction Clutches

40 Years on the Market

Over 200,000 in Operation

1925 Catalog Sent Free on Request

Ask for Catalog M

The Moore & White Company
2707 to 2737 N. 15th St.
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CULLMAN

In stock and to order. Let us quote on your sprocket requirements.

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CULLMAN WHEEL CO.
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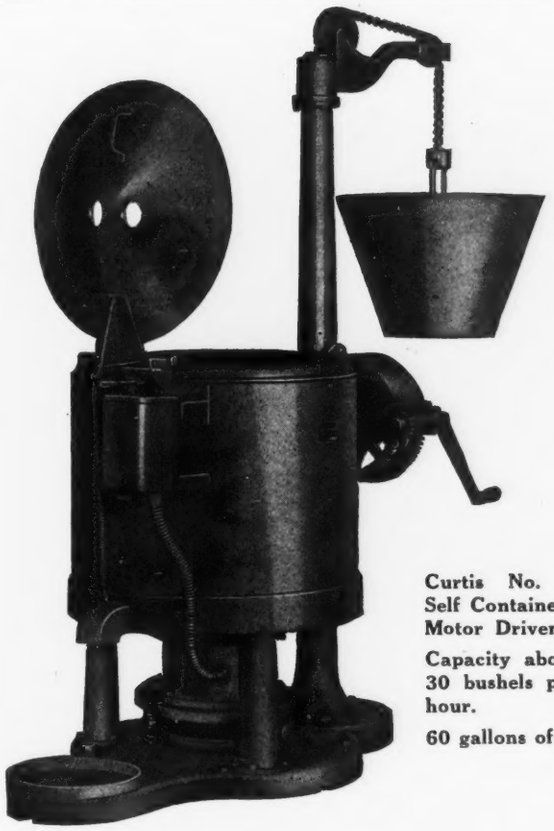
SPROCKETS



Curtis No. 500
Self Contained
Motor Driven.
Capacity about
30 bushels per
hour.
60 gallons of oil.

Neglected Profit

How many bushels of chips containing *some* oil do you throw out every day?

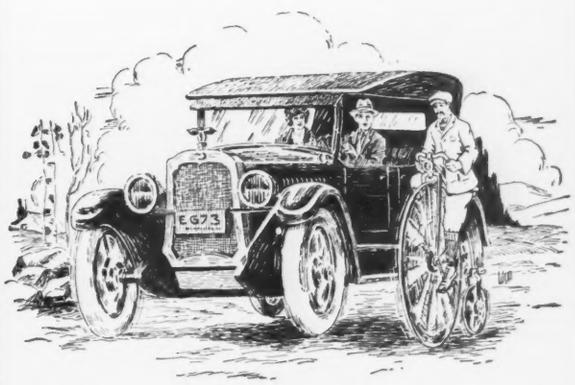
With the average bushel goes more than two gallons of cutting oil—worth sixty cents or more. *Prove this by your oil bills.*

Can you afford to neglect this when you can easily save practically all of this oil and use it over and over?

The Curtis Centrifugal Oil Extractor recovers 90% of the oil held by chips, from automatic screw machines, slotters, etc. Costs little to operate it; takes little labor and little time and often pays for itself and yields a good profit the first month. Let us tell you more about it.

If you use as little as six barrels of cutting oil a year there is a Curtis to suit your needs.

THE LEON J. BARRETT CO.
Successor to Curtis Machine Company
1475 Grafton St. Worcester, Mass.



From the Days of the High Wheel Bike—

TUCKED away in the heart of Maryland is a factory that for half a century has been keeping in step with American industrial progress. From the days of the "high wheeled bike" to the present era of de luxe motor cars, this factory has been producing quality products—products of the motive sort that have contributed much towards the pleasure and relaxation of all classes.

Through successive steps, from the manufacture of the ancient, high wheeled bicycle, the pneumatic tired "two wheeler," to the production of a present day quality motor car, this plant has used T. B. Wood's Power Transmission Machinery.

Installed years and years ago, Wood's Products are still performing efficiently and satisfactorily. And they will continue to perform in that manner, for Wood's Power Transmission Appliances are built to endure.

When you install Wood's Cast Iron Hangers and Pulleys you assure your factory a life time of dependable power transmission performance.

T.B.Wood Sons Co.,
Chambersburg, Pa.

NEW ENGLAND BRANCH:
Cambridge, Mass.

SOUTHERN BRANCH:
Greenville, S.C.

Makers of Power Transmission Machinery Since 1857

BY INVITATION MEMBER OF

Shafting, Hangers, Pulleys, Flexible Couplings, Friction Clutches and the U. G. Short Center Belt Contactor.

GLOBE TUMBLING BARRELS

PREDICTIONS are that those concerns with the most efficient and economical production will survive the intense competition ahead.

Those companies using Globe Tumbling Barrels are set to meet the situation for Globe Barrels eliminate and augment expensive hand labor, speed production, thereby cut the "cost-to-make."

The Globe Machine & Stamping Co.
1255 W. 76th St., Cleveland, Ohio

A few of the fifty different types

GREASE CUPS *and* OIL CUPS

THE proper lubrication of the machines you build depends largely upon the means you provide for it. Empress Grease and Oil Cups have done the job for years on all types of machinery—they will solve your lubrication problem. There is an Empress Cup for every need.

Complete data on these cups and over fifty other types is given in Booklet No. J-103. Write for it.

BOWEN PRODUCTS CORPORATION
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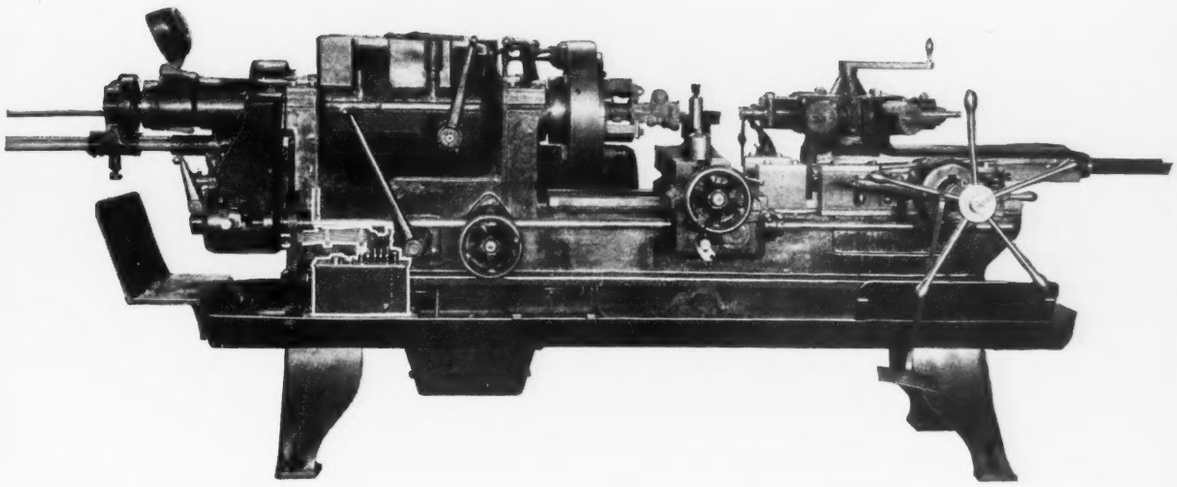
Manufacturers of Empress Lubricating Devices since 1890

Madison-Kipp Fresh Oil Systems Fit Readily Into Any Machine Tool Design



EVEN on machine tools now in use the application of Madison-Kipp Lubricators is a simple engineering and tool room job.

While it is preferable that these lubricators be applied at the time the machine is built, they may be added and proper leads installed on machines now in use.

Shown above is an application of the Madison-Kipp Fresh Oil System on a lathe. This was applied after the machine left the factory.

Because they have decided that lubrication of the bearing points should not be left to the operator many machine tool builders have installed Madison-Kipp Machine Tool Lubricators as standard equipment. They can be installed on many other machine tools on specification.

The new Madison-Kipp can be regulated to feed just the right amount of fresh oil for each bearing requirement.

Because it is *fresh oil,* it provides the unbroken protecting film that no used oil could offer. Because the supply is thoroughly regulated, there is no waste.

Perhaps most important of all, the Madison-Kipp operates automatically with the machine, so there is no chance for neglect and no operating time lost for oiling.

Madison-Kipp Machine Tool Lubricators are flexible as to size, oil feed adjustment, type and drive location.

We will be glad to send you special data on a variety of machines.

NATIONAL STEEL & MACHINE TOOL EXPOSITION CHICAGO

MADISON-KIPP LUBRICATORS

Madison-Kipp Corporation

Lubrication Specialists Since 1898 ***Madison, Wisconsin, U. S. A.***

HOYT SOLDER

FINEST materials, time-proven formula and expert amalgamation are necessary to produce perfect solder. HOYT Solder is made by a process based on half a century of experiment and research. That's why it is regarded as standard.

HOYT BABBITT

NO matter what the cost, you could buy no finer Babbitt than HOYT'S Genuine "A". It is made by processes that have taken years of research work to perfect. It may be truly said that Genuine "A" is the perfect Babbitt Metal for the highest grade machinery. A trial order will convince you that the years spent in searching for the "perfect" Babbitt were not wasted.

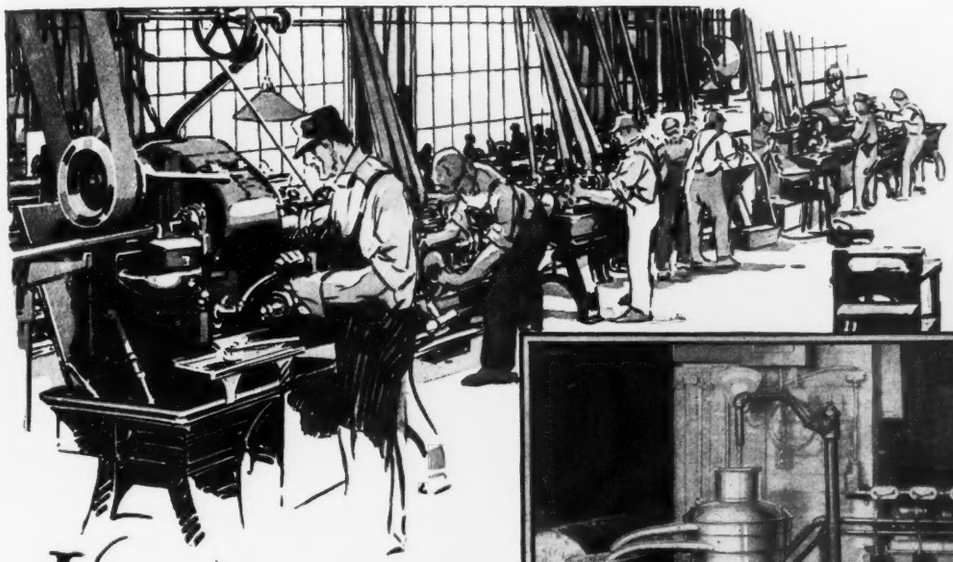
EAGLE "A"

WHERE it is not necessary to use such superb Babbitt as HOYT'S Genuine "A", Eagle "A" is the most logical substitute. It is by far superior to anything in its price class.

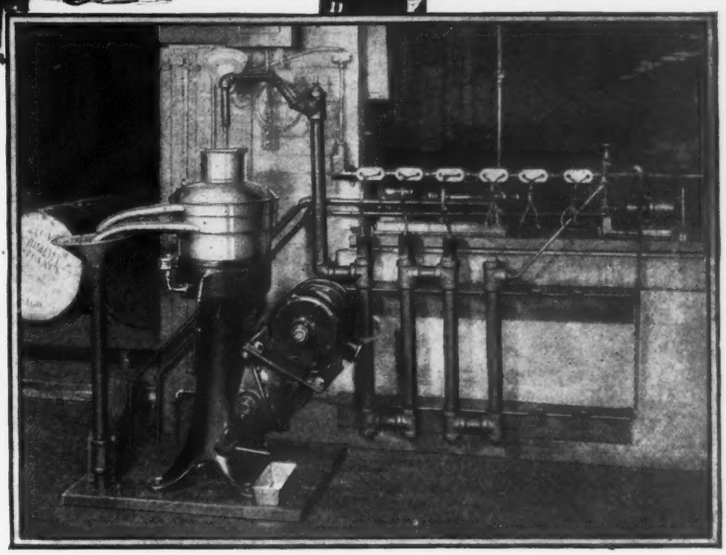
HOYT METAL CO.
St. Louis
New York Chicago Detroit

Tolhurst Chip Wringers reclaim 6 to 15 gallons per load and handle three or four loads an hour.

TOLHURST MACHINE WORKS
TROY, N.Y.



All of the oil purifying equipment aboveground at the American Nut Company is shown in the accompanying illustration.



Lower costs on screw machine output ——

The American Nut Company, of Detroit, Mich., manufacturers of "Anco" nuts, have found the De Laval Multiple Clarifier an effective means of reducing cutting oil costs. It was inevitable, too, that having installed a Purifier to reduce oil costs, an improvement in the product due to the constant use of freshly purified oil would also be noticed.

In this connection, the following excerpt from a letter written by Mr. J. C. Wilkie, Secretary and Treasurer of the company, will be of interest:

"While we cannot give you any data on oil saved, longer life of tools, etc., we do know that the oil from the Clarifier is clean. We recently had an analysis made of this clarified oil and it showed that the original mix (20 parts of red engine oil to 1 part of super cool base) was intact, sulphur present and but .007 of 1% foreign matter. This last figure prompted us to put all of our new oil through the Clarifier before using it, which is now a regular procedure with us."

When it is a demonstrated fact that clean cutting oil which protects tools and insures better work is cheaper than that loaded with impurities, why delay longer the installation of De Laval oil purifying equipment?

The De Laval Separator Company

NEW YORK
165 Broadway

CHICAGO
600 Jackson Blvd.

DE LAVAL PACIFIC COMPANY
SAN FRANCISCO

De Laval Oil Purifiers

Please tell us how we can improve our product and reduce costs as related to the problem checked:

☐ **Extracting oil from chips.**
☐ **Purifying cutting oil.**

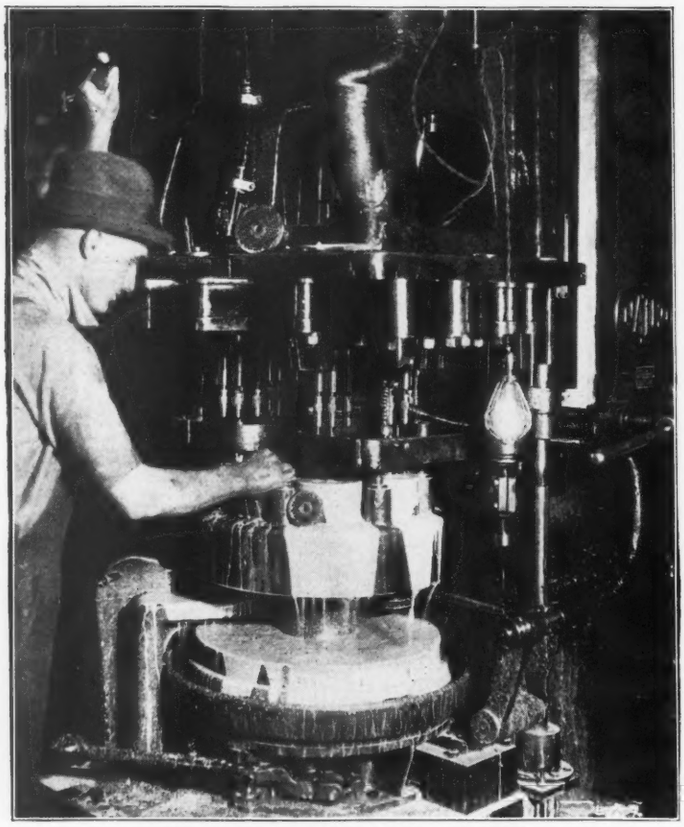
Company .....

Individual .....

M-543M

Address .....

USED SUNOCO FOR YEARS



COURTESY OF HOBART MFG. CO., TROY, OHIO

The Hobart Manufacturing Company of Troy, Ohio, makers of electric food preparing machines, have nothing but the highest recommendation for Sunoco.

NATURE OF WORK
DRILLING 102 HOLES IN MEAT GRINDER PLATE

MACHINE
NATCO MULTIPLE SPINDLE DRILL PRESS

MATERIAL
S. A. E. 1020 DROP FORGING

PRODUCTION
35 PIECES PER HOUR

FEED
.004 PER REVOLUTION

SPINDLE SPEED
800 R. P. M. USING 3-16 IN. HIGH SPEED DRILL

CUTTING OIL
SUNOCO EMULSIFYING CUTTING OIL, 1 PART TO 15 PARTS WATER

RESULTS
SEARCHED THE FIELD FOR A SATISFACTORY EMULSIFYING CUTTING OIL, AND PROVED THAT SUNOCO GAVE THE MOST SATISFACTORY RESULTS. NOW AFTER YEARS OF USE THEY HAVE NOTHING BUT THE HIGHEST PRAISE FOR IT

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
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BOOTH NO. 178

Facts About Sunoco Emulsifying Cutting Oil

A pure, soluble oil, which does not deteriorate or separate. Prolongs tool life to a marked degree. Improves the quality of the finish. Allows higher production, and cuts costs to a sometimes unbelievable degree.

Write our nearest office for complete information

SUNOCO
EMULSIFYING CUTTING OIL

SUN OIL COMPANY, *Philadelphia* · SUN OIL COMPANY, Limited, *Montreal*

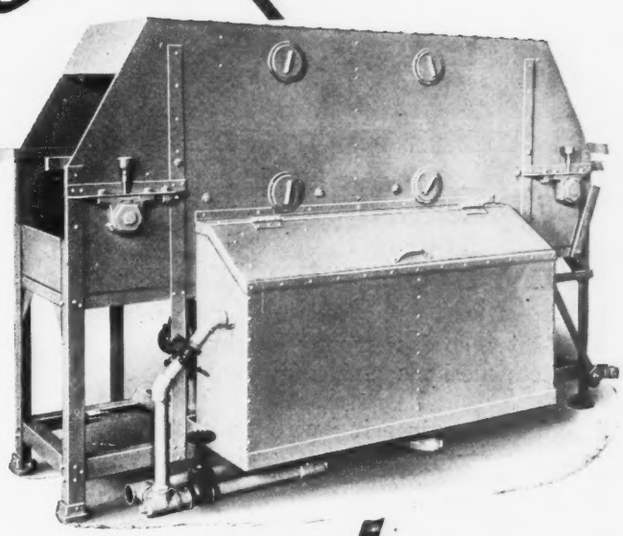
AKRON	BATTLE CREEK	CINCINNATI	DETROIT	MONTREAL	SYRACUSE
ALBANY	BOSTON	CLEVELAND	FLINT	NEWARK	TOLEDO
ALLENTOWN	BRIDGEPORT	COLUMBUS	GRAND RAPIDS	NEW YORK	TORONTO
ATLANTIC CITY	BUFFALO	DALLAS	JACKSON, MICH.	PITTSBURGH	TULSA
BALTIMORE	CHICAGO	DAYTON	JACKSONVILLE	PROVIDENCE	

This Way

The Colt Autosan

TRADE MARK

Colt Autosan Metal Parts Washing Machines.
Eight Standard sizes; special machines for special purposes.



for Extra Profit

There is a way to realize an extra profit—through cleanliness.

Oil, chips, and dirt adhering to parts are sources of inaccuracy, spoiled work, and lost time. Put in a Colt Autosan and watch production jump, and spoilage decrease.

The Colt Autosan is a continuous, automatic washer. Force fed jets of harmless, non-inflammable cleaning solution, followed by floods of fresh rinsing water wash away every particle of the most tenaciously clinging dirt.

For cleaning work in process, or for the final cleanup before it goes out—the Colt Autosan saves space, time, chemicals, and eliminates the fire hazard of benzine or gasoline. In a year the savings made with a Colt Autosan will total many times its cost in extra profits.

COLT'S PATENT FIRE ARMS MFG. CO.

HARTFORD, CONN., U. S. A.

Special Equipment Section

Special Machinery, Screw Machine Products
Drop Forgings, Fixtures, Tools, Dies, Jigs, Castings
Die Castings, Stampings, Contract Work *and* Designing

Why Procrastinate?

TIME flies, so does money lost by using obsolete methods and equipment.

By intelligent engineering we stand ready to increase your production, thereby reducing your cost to its lowest level.

With us the first cost is the only cost.

Our specialty is designing complete ultra-cost-reducing tool equipment—special automatic labor saving machinery that is a real labor saver; also assembly planning, time study and efficiency work, in fact, engineering in all its branches.

A staff of highly specialized engineers, and a well trained drafting force are at your disposal.

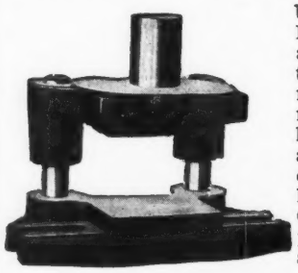
Write us today.

RELIANCE DIE & STAMPING CO.

Engineers and Builders of High Grade Tools, Dies and Special Automatic Machinery.

501-511 N. LaSalle St. CHICAGO, ILL.

Accurate—Long Wearing—Low Cost



U. S. Tool Standard Sub Presses and Die Sets are accurate, long wearing, and their cost is in most cases much less than you can make them for. We have large and complete stocks and can usually ship your order within twenty-four hours. Let us send you Catalog M and compare prices—send us an order and compare service.

U. S. TOOL COMPANY, Inc., Ampere, N. J.

Philadelphia Representative
2401 Chestnut Street, Philadelphia, Pa.

DEPENDABLE
JIGS, FIXTURES, TOOLS & DIES
"Quality Workmanship"
The PENNSYLVANIA TOOL & MANUFACTURING CO.
YORK, PENNA.

Production Engineering

Consulting and Designing

Practical Engineering Advice

If you are wrestling with a knotty production or designing problem—let us help you. "Two heads are better than one"—and the experience we have gained in solving hundreds of the most varied industrial problems will prove a valuable aid in finding a solution for yours.

We work with you in an intense and thoroughly practical way, and you begin to see almost immediate results from our recommendations. A long record of successful achievement is evidence of integrity, cooperation and sound engineering. Whatever your problem—you can depend on us to find the one best way to solve it.

O. C. Kavle, L. W. Moulton and Staff of Associate Engineers and Designers—Known as

Manufacturers' Consulting Engineers

McCarthy Building, SYRACUSE, N. Y.

Cost-Cutting SPECIAL MACHINERY

What is the meaning of "Special Machinery"? Why —machinery designed and built for meeting the special needs of a manufacturing enterprise.

We have been originating, designing and building special machinery for more than 20 years. Our experience has valuable applications in every line of manufacture.

ASK US ABOUT WORK DONE.
TELL US ABOUT WORK TO DO.

The Columbus Die, Tool & Machine Company

COLUMBUS, OHIO

ROUND DIE SET

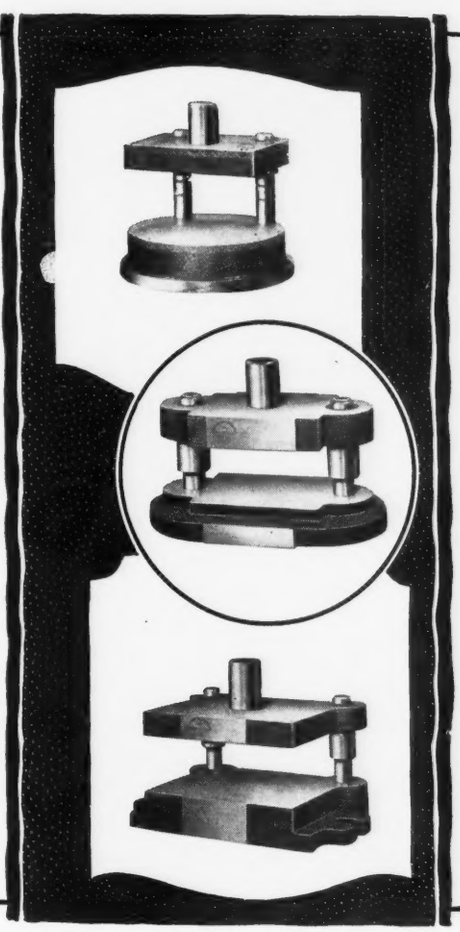
Just one of the 12 types —useful for average press work for round dies.

CENTER PIN TYPE

recommended for close stamping work, where shut-height of press does not permit use of floating adapter type of die set.

HEAVY DIE SHOE —LIGHT PUNCH HOLDER

recommended for heavy press work where strength of die shoe must be considered.



12 VARIETIES

—with hundreds of combinations

Simplification achieves a radically new standard of simplicity where **Danly Die Sets** are used. The 12 types and 97 sizes suffice for every need of stamping production.

Danly Die Sets in the "knock-down"—permitting interchangeability of punch holder and die shoe according to requirements—increase the flexibility enormously while minimizing investment and overhead.

Do you know you can save 20 to 50% in first cost alone, by using **Danly Die Sets?** Why bother with making your own and all it implies, when a few minutes suffices to order just the type and size you need from the Danly 34-page catalogue?

See our exhibit, Booths 209-213, National Steel & Machine Tool Exposition, Chicago, Sept. 20-24.

Write nearest warehouse for catalogue. Immediate delivery from stock.

DANLY MACHINE SPECIALTIES, Inc.

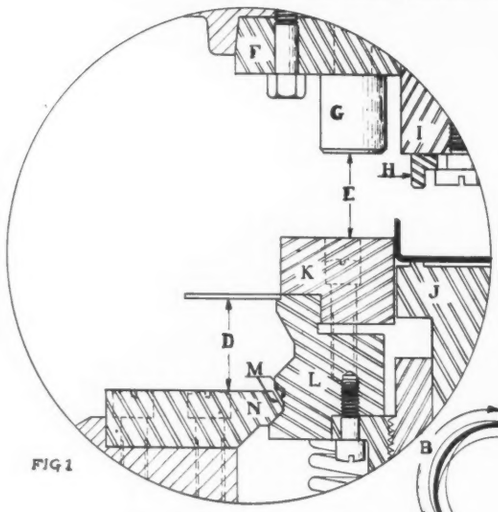
4907 Lincoln Avenue

Detroit, Mich. 1537 Temple Avenue — **CHICAGO** — **Long Island City, N. Y.** 35 Wilbur Avenue

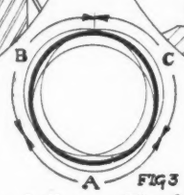
Use **DANLY** DANLY STANDARD *Die Sets*

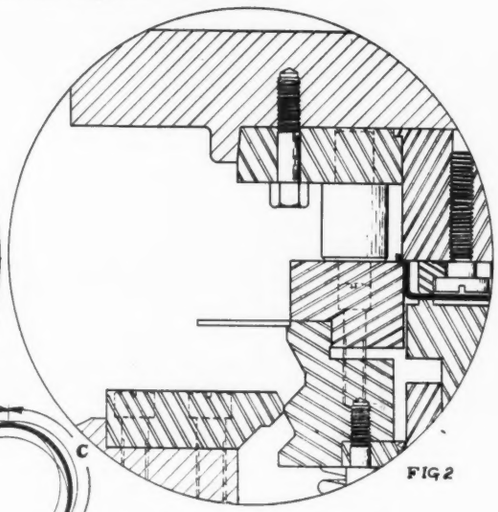
BREHM PATENTED TRIMMING DIES

For Trimming Flat Edges on Drawn Shells of Regular or Irregular Shapes



Cross-Section of Die With Shell to be Trimmed.





Cross-Section Showing How Metal is Removed.

As the press slide descends the punch enters the shell and the studs "G" force the cam block "L" down. During this downward movement the cams at point "M" force the die members in a lateral direction toward the punch "I", shearing the scrap stock off as shown in Fig. 2.

Fig. 3 shows portions of scrap, A, B, and C, cut by the three cams. Most flat edge trimming can be accomplished in a three cam die, while all notching dies must be made with four cams. All these dies are for use in standard presses.

Write for information. Quotations can be made upon receipt of blanks to be trimmed or from blue prints.

THE STEEL PRODUCTS ENGINEERING CO., Springfield, Ohio

AVERBECK SHAPERS — SPECIAL MACHINERY

POORMAN MADE THESE PARTS

And they're only 3 samples of what we can do. Any screw machine or stamped work up to 3½ inches is within our limits. Devotion of our entire facilities to the smaller sizes permits us to produce what you want, within our limits, on a quantity basis and cheaply.

We will gladly estimate on your blue prints or samples—try Poorman on your next work.

J. E. POORMAN

1825 Bristol Street — Philadelphia, Pa.

TRADE **MEHL MADE** MARK

HIGH GRADE

JIGS, FIXTURES, DIES, GAGES AND SPECIAL MACHINES

SEND FOR FREE ILLUSTRATED PROSPECTUS

MEHL MACHINE TOOL & DIE CO.

Established 1913

30 Minutes from New York City — ROSELLE, NEW JERSEY

LET US BE YOUR TOOL-ROOM

Dies, Tools, Jigs, Gages, Fixtures, Etc.

We have the reputation for producing tools that are fool-proof, easy to manipulate and give the largest possible production.

Quality—Prompt Delivery—Fair Price

Arthur Brock Tool & Manufacturing Works, Inc.

533 North 11th Street — Philadelphia, Pa., U. S. A.

Engineering Development Research, Dies, Tools, Special Machinery

SMALL **STAMPINGS** MEDIUM

The **BANNER** DIE, TOOL AND STAMPING CO.

529-31 N. Park Street — Columbus, Ohio

The Stewart engineering department where specialists design customers' dies and adapt customers' products to the Stewart process of die casting

Die design determines casting costs

THE Stewart engineers are specialists devoted to the design and development of dies and die casting by the Stewart process. Much of Stewart success in die casting intricate parts is due to the experience and ingenuity of the engineering staff of the Stewart organization.

The intimate knowledge and seasoned experience of these engineers are at the service of manufacturers. Constructive suggestions for improvement of product and its adaptation to die casting often follow consultation with prospective customers.

Die design is executed in a modern tool room equipped to manufacture dies as economically as is consistent with the best results.

Close chemical and metallurgical control of metals and processes and rigid inspection of die castings insure uniform quality even with the huge Stewart capacity for production.

The Stewart engineers and metallurgists are at the disposal of manufacturers for advice and co-operation without obligation.

THE STEWART DIE CASTING CORPORATION

formerly STEWART MANUFACTURING CORPORATION

4500 FULLERTON AVENUE . . . . . CHICAGO

Direct Factory Representatives in

Detroit Milwaukee
Cleveland Los Angeles
San Francisco
New York City
Birmingham Pittsburgh
Indianapolis St. Louis

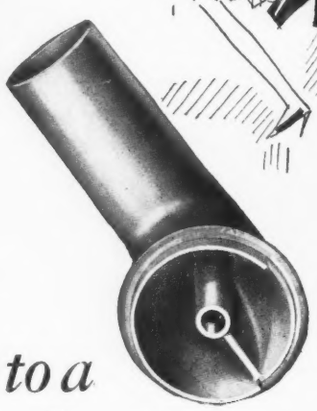
Stewart

M8-Gray

[Die-castings are used for many purposes today—frequently in places you never thought of. This advertisement is one of a series designed to show some interesting uses of die-castings made by us.]

When you dance to a phonograph

die-castings help to bring out the tone



This die-casting is part of the tone arm of a phonograph. It is one of several die-castings made by us that are used in talking machines.

Rugs rolled up and pushed out of the way—the rhythmic moan of a popular dance record—the neighborhood Charleston club holding its regular meeting—an extremely disgusted father vainly seeking a quiet place to read.

The phonograph is only one of many familiar machines and appliances that contain die-cast parts made by us.

We make die-castings of aluminum, zinc, lead and tin alloys. They are made in every required size and shape. They are made to exact specifications. Moreover, in ordering from us, you buy from a concern large enough to make die-castings in any quantity and make them economically. The quality of our die-castings is guaranteed to be of the same high standard that has made the Dutch Boy trade mark stand for the best in babbitts, solders and paint materials.

Whether you have a new product or an old one, you may be able to save money by having certain parts die-cast. It will cost you nothing to find this out. Our experienced technical staff is at your service.

NATIONAL LEAD COMPANY

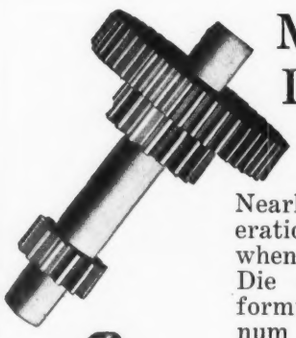
Die-Casting Division

111 Broadway **New York, N. Y.**

Western Representatives: E. R. McCormick, 2599 Cadillac Ave., Detroit, Mich. A. H. Bergedick, 667 Bowen Street, Dayton, Ohio. A. A. Gildemeister, 444 4th Street, Toledo.

ALUMINUM, ZINC, LEAD *and* TIN

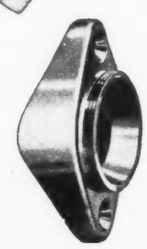
DIE-CASTINGS



McGill Metal Die Castings are Accurate

Nearly all machining operations can be eliminated when you use McGill Metal Die Castings — a special formula, modified aluminum bronze poured into permanent steel moulds. Every casting is accurate to .004″,—effecting large savings because less metal goes to the scrap pile.

McGill Metal is very practical over a wide range of work, is malleable, ductile, non-corrosive and is as strong as steel.



Physical Properties

Tensile Strength	75,000 lbs.
Compressive Strength	120,000 lbs.
Elongation	18 to 20%
Elastic Limit	30,000 lbs.
Hardness, Rockwell B Scale	75-80
Hardness, Brinnel	130

Send blue prints or samples for estimate

McGill Metal Co.

Valparaiso, Indiana

WICACO

Screw & Machine Works, Inc.

Stenton Ave. and Louden Street **PHILADELPHIA** Wayne Junction P. & R. R. R.

Established in 1868=59 years of continuous production

Precision and Production

Automatic Screw Machine Parts

All Metals; All Sizes

Cornine-Hakanson Die-Casting Co., Inc.

402 East 152nd Street, New York City

Phone Melrose, 10125

Alloys in Aluminum, Tin, Zinc and Lead

Quotations from blueprint or model

JIGS-TOOLS-DIES

Our equipment includes Pratt & Whitney Jig Boring Machine, Lucas Boring Mills, Gray Planers, Die Filing Machines. Prompt Service. Try us.

AMERICAN TOOL & MANUFACTURING CO.

URBANA, OHIO

A CARD WILL BRING OUR CATALOG

BACKED BY 34 YRS.

FRANKLIN DIE-CASTINGS

EXPERIENCE

A Dependable Source of Supply

Over 20 years ago Franklin engineers produced the first die-cast drill stand. Today most of the drill manufacturers order Franklin metal drill stands.

Just one of the many uses found for Franklin die-castings in the last 34 years. Let us have your problems.

Write for booklets "Franklin Die-Castings in Modern Inventions", and "Die-Casting"

Quotations on receipt of samples or blueprints

FRANKLIN DIE-CASTING CORPORATION

Syracuse, N. Y.

Dependable

SUPER CAST

Die Castings

The Superior Die Casting Co.

Cleveland, Ohio

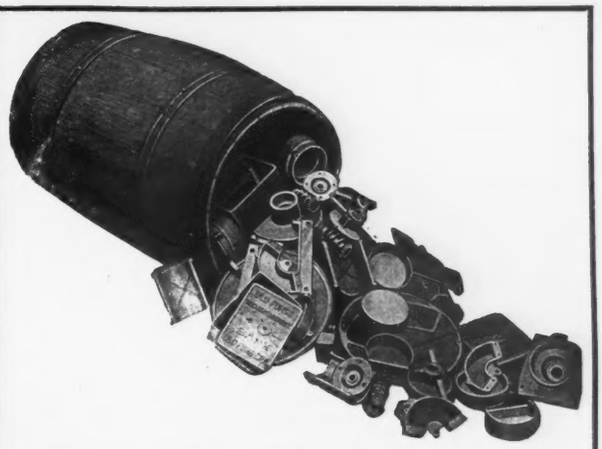
Safeguard Your Production Schedule

by specifying Alemite die-castings. Don't take chances with an unreliable source of supply. The country's foremost manufacturers depend upon us for quality die-castings, delivered on time. *We are geared for high production work.*

Send blueprints or samples for quotations

Alemite Die Casting & Mfg. Company

2640 Belmont Avenue **Chicago, Ill.**



Phoenix Die Castings Cut Machining Costs

The Phoenix method of forcing metal into every corner and crevice of the dies under pressure produces castings that are exceptionally hard—dense—durable and so accurate that they require practically no machining.

The uniformity of duplicate parts and the absence of rejects eliminate the need of inspection.

Phoenix Die Castings are so well finished that, in many cases, further machining is unnecessary.

Let us estimate on your work.

PHOENIX DIE CASTING CO.

Established 1907 **BUFFALO, N. Y.**

SPINDLES
ARBORS
GEAR BLANKS
WELDLESS RINGS
ENGINE SHAFTS
AXLES, ETC.

Try them on
Your Next Order

PROFITABLE FORGINGS

J & J Forgings are very close to finished dimensions—which means a saving for you of both time and money—an important reason why these forgings are profitable.

The same care that keeps dimensions within close limits produces forgings of much more than ordinary quality—at a cost no more than for any good forging.

We can make unusually prompt deliveries on the largest work or the largest quantity of work. Send us your blue prints or sketches for an estimate.

THE JOHNSTON & JENNINGS CO.

INCORPORATED 1894

Addison Road and Lake Shore
R. R. Tracks

CLEVELAND, OHIO, U. S. A.

DYSON FORGING SERVICE

Dollar for dollar Dyson Forgings give the best value because they are closer to finished dimensions, are uniform in physical properties, and because Dyson Heat Treating Processes give up to 12% greater tensile strength, and 100% greater reduction of area than ordinary annealed steel—at no greater cost. And Dyson keeps promises on delivery dates. Anything from a 3 Inch Nut to a 5 Ton Shaft.

Let us estimate on your work.

Joseph Dyson & Sons
CLEVELAND, OHIO, U. S. A.

You'll Save Money

by contracting with us to build your machinery. Ask us and ask our clients.

SWEET & DOYLE FOUNDRY & MACHINE CO.
TROY (Green Island), NEW YORK

DIE-CASTINGS

Standard Alloys
Send us blueprints or models

Republic Die Casting Company, Inc.
128E Mott Street NEW YORK CITY

Sterling DIE CASTINGS

Die Castings in Aluminum, Zinc, Tin and Lead Alloys
If You Value Quick Action and Real Cooperation, Let Us Quote.
DEPENDABLE DELIVERIES
STERLING DIE CASTING CO., Inc., 749 39th St., Brooklyn, N. Y
DETROIT OFFICE, 8242 Woodward Avenue

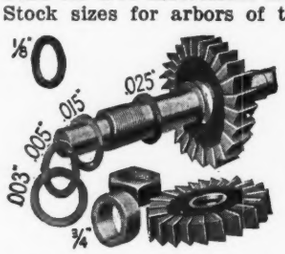
DIE CASTINGS SINCE 1908

Send Us Your Inquiry SOSS *We Will Estimate from Your Blueprints*

SOSS MANUFACTURING CO. 776 Bergen St., Brooklyn, N. Y.

Steel Spacing Washers

Send for free assortment in the sizes you use most. Stock sizes for arbors of the following diameters:



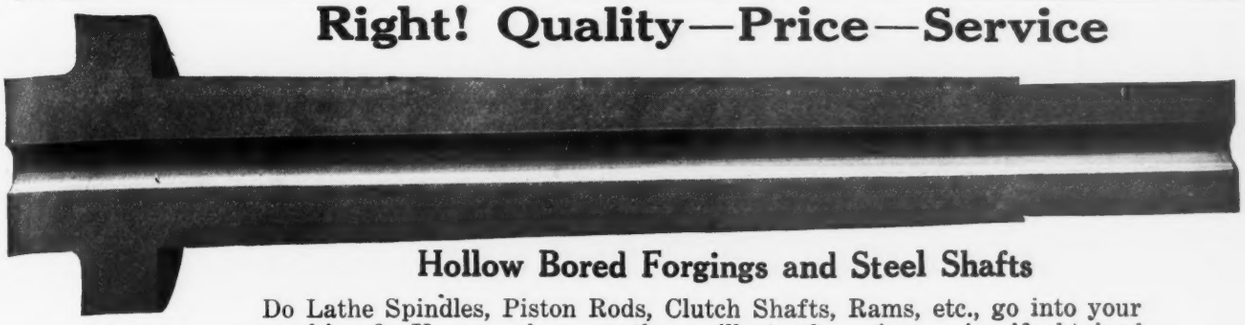
⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 2¾, 3, 3½ and 4 inches and larger.

Stock Thicknesses: .001, .002, .003, .004, .005, .006, .007, .008, .010, .012, .015, .020, .025, .032, .047, .063, .093, and .125 inch.

Spacers thicker than ⅛" are turned from tubing but not carried in stock.

DETROIT STAMPING CO.
3445-3459 West Fort St. DETROIT, MICH.

Right! Quality—Price—Service

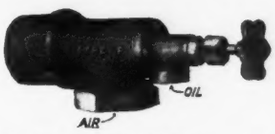


Hollow Bored Forgings and Steel Shafts

Do Lathe Spindles, Piston Rods, Clutch Shafts, Rams, etc., go into your machines? You can be sure they will stand up in service if obtained from us. Try us on your next order. Estimates gladly given.

AMERICAN HOLLOW BORING COMPANY, ERIE, PA.

S. C. & H. Industrial Furnace Room Accessories



S. C. & H. Low Pressure Oil Burner. Three Sizes.

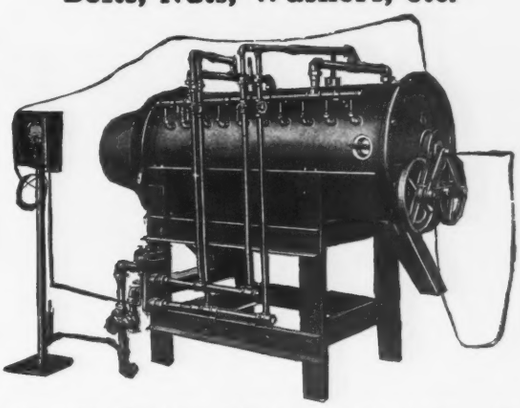
A Sure Way To Reduce Heating Costs

Use S. C. & H. type "P" Oil Burners. They are simple in construction, which insures you freedom from frequent repairing. Their construction permits fine adjustment, which makes them very efficient in operation. They are made in three sizes, 1¼", 2" and 2½"; and operate on an air pressure of 16 ounces per sq. in.; and an oil pressure of 12 pounds per sq. in. Send for catalog No. 14 which describes completely S. C. & H. Oil Burners.

The Strong, Carlisle & Hammond Co.
1393 W. 3rd St., Cleveland, O.

[*M'f'rs of S. C. & H. Oil, Gas, or Electric Industrial Furnaces*]

For Automatically Heat Treating Bolts, Nuts, Washers, etc.



No. 136 Heating Machine with Automatic Heat Controller capacity for hardening or annealing 200 pounds per hour.

Capacity of No. 139 Heating Machine (same style as No. 136 but larger) 1000 pounds per hour.

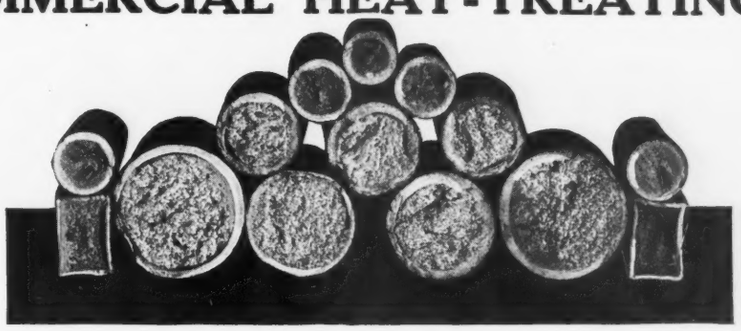
Uniform heat treatment at low cost per pound. Write for complete information.

AMERICAN GAS FURNACE CO.
Elizabeth, New Jersey

WE DO COMMERCIAL HEAT-TREATING

including—

CASE-HARDENING
HARDENING
ANNEALING
TEMPERING
GUN METAL
COLORING, ETC.



AMERICAN METAL TREATMENT CO. Spring and Lafayette Streets ELIZABETH, N. J.

When to Quench *And Why!*

Tool type Hump Electric Furnace—Equipment Complete—Patented

THE new issue, recently off press, of L & N Catalog No. 90-Y has been enlarged to include two pages each on the hardening of the following groups of heat-treated parts:

Blanking Dies and Cutting Tools

Forming Punches, Dies and Molds

Drop Forge and Die Casting Dies

Stamping Dies

Cold Heading and Thread Rolling Dies

Production Parts

Facts given are definite—the recorded results of practical experience. The reasons for distortion, warpage, sinking, breakage, the causes of short life, and the remedies in each case, are outlined in detail.

A copy of the 40-page booklet will be sent free on request without obligation

Write for Catalog No. 90-Y

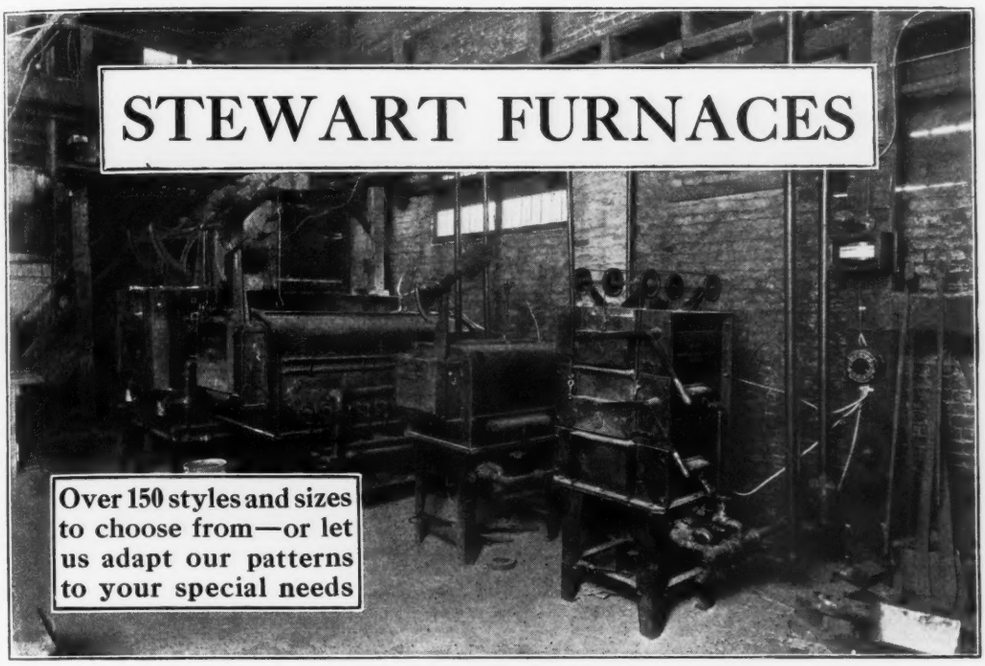
LEEDS & NORTHRUP COMPANY
4901 STENTON AVENUE, PHILADELPHIA

LEEDS & NORTHRUP

CHICAGO, ILL. LOS ANGELES, CALIF. SAN FRANCISCO, CALIF. CLEVELAND, OHIO.

Catalog No. 90-Y
The Hump Method for Heat Treatment of Steel

Catalog No. 93-Y
The Homo Method for the Drawing of Steel



A section of the Martin Forge Co. heat treating room

Martin Forge Co's. experience may give you some ideas on heat treating

After a 7-year test, they select Stewart Furnaces exclusively

THE Martin Forge Co. bought a Stewart No. 25 Oven Furnace in 1918. About two months ago they bought a new fire clay hearth for this furnace at a cost of $17.00. Please note that this expense occurs seven years after the furnace was installed.

This performance satisfied the Martin Forge Co. on the worth of Stewart Furnaces. They have just installed the most modern commercial heat-treating department in the east—100% Stewart. Read their letter shown at the right.

Thousands of other plants all over the United States depend on Stewart Furnaces for their perfect heat treating results. That is why Stewart Furnaces have been the world's standard for more than 36 years.

The Right Furnace at the Lowest Cost

We maintain a staff of engineers of long, practical experience who are experts in showing you how to get the very best kind of furnace for your special needs, at the lowest possible cost. Our experimental department is constantly devising new methods and improvements which increase our business because they materially help yours.

Our large stock of patterns enable us to give you exactly what you want, with a minimum loss of time and expense. When necessary, we gladly build to your special requirements. Our products are nationally known and endorsed by many of the largest manufacturers in the world. It costs nothing to have us quote. You will find our service cheerful as well as intelligent.

MARTIN FORGE CO.
Brooklyn, N. Y.

Gentlemen:

We selected Stewart Furnaces only after a very careful study had shown us that they were the most suitable for all around heat treating. Our work consists of annealing, carburizing, cyanide hardening, and the hardening of tool steel. We use your Double Deck Furnace for hardening high speed steel.

As you know, we had in use for the past seven years, one of your Stewart No. 25 Oven Furnaces for annealing, and our total expense of upkeep during all these years consisted of a new hearth which we purchased recently and which cost us $17.00.

We have been complimented by our numerous customers for whom we do heat treating, as to the quality of work we are turning out, and we attribute this in no small degree to our very complete Stewart Furnace installation.

Yours very truly,
Martin Forge Co., Inc.
(Signed) L. Walker Martin, President.

Spend 2 Cents for 36 Years' Experience

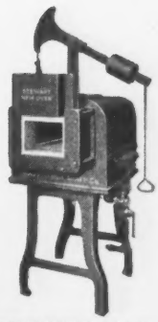
Tell us your heat treating requirements—we'll recommend the proper furnace installation.

Let one of our practical representatives call and discuss the subject with you.

Drop us a line now. You'll never get a bigger 2-cent stamp's worth.

CHICAGO FLEXIBLE SHAFT COMPANY, 1154 S. Central Ave., Chicago
36 years making quality products

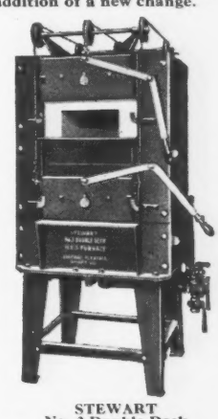
15 Park Row, New York City, N. Y.
608 Sweetland Building, Cleveland, Ohio
211 S. Foster Ave., Lansing, Mich.
Pioneer Bldg., St. Paul, Minn.
4507 McPherson Ave., St. Louis, Mo.
1200-01 Standard Life Bldg., Pittsburgh, Pa.
943 Granite Bldg., Rochester, N. Y.
768 Mission St., San Francisco, Calif.
79 Milk St., Boston, Mass.
306 Sycamore, Cincinnati, Ohio
1738 Nineteenth St., Milwaukee, Wis.
4805 Park Ave., Indianapolis, Ind.
Room 310 Wesley Bldg., Philadelphia, Pa.
1208 Starks Bldg., Louisville, Ky.
Canadian Factory, 349 Carlaw Ave., Toronto



STEWART No. 14 Oven
Indirect Heat Type
Built for the heat treatment of carbon and high speed steels. Regularly equipped with fire clay hearth and supports. When used for high speed steels, carbofrax hearth and supports are supplied.

STEWART
No. 1214 Pot Furnace
Stewart Pot Furnaces are built for lead, salt or cyanide hardening, but can be satisfactorily used for soft metal melting, or for tinning and galvanizing.

STEWART
Oil Tempering Furnace
These Furnaces are designed to heat the oil bath slowly to the drawing temperature and to cool rapidly to permit the addition of a new change.



STEWART
No. 3 Double Deck
For the heat treatment of carbon and high speed steels. The upper preheating chamber is heated by the waste flue gases from the lower high heat chamber. Upper chamber used for pre-heating and drawing high speed steels. Has extra set of burners for upper pre-heating chamber.

Strand

FLEXIBLE SHAFTS

"STRAND" FLEXIBLE SHAFTS AND EQUIPMENTS

CAN BE PURCHASED
THROUGH THE FOLLOWING AGENCIES IN THE UNITED STATES

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT. 20-25
BOOTH NO. 77

*BOSTON—Lee W. Woolston.
BALTIMORE—Industrial Supply Co.
*BUFFALO—Beals, McCarthy & Rogers, Inc.
CHICAGO—N. A. Strand & Co. and all Dealers.
*CLEVELAND—Strong, Carlisle & Hammond Co.
*CINCINNATI—Boebinger Hdwe. & Supply Co.
*DETROIT—Boyer-Campbell Co.
*DENVER—A. F. Krippner.
*HOUSTON—Brazelton, Wessendorff & Nelms.

*Stock of Machines.

*LOS ANGELES—M. B. Sawyer.
*LOUISVILLE—Neill-LaVielle Supply Co.
*MILWAUKEE—E. L. Essley Machinery Co.
*NEW YORK—W. B. DaSilva.
PHILADELPHIA—D. Nast Machinery Co.
*PITTSBURGH—Machinists Supply Co.
*ST. LOUIS—Corby Supply Co.
*SAN FRANCISCO—M. B. Sawyer.
*SEATTLE—M. B. Sawyer.
*TOLEDO—Freeman Supply Co.

ORIGINATORS—DESIGNERS AND MANUFACTURERS

5001-5009
NO. LINCOLN ST.

N. A. STRAND & CO., Chicago

No Smoke — KASENIT TRADE MARK REG. U.S. PAT. OFF. — No Fumes

Non-Poisonous—Non-Explosive—Non-Inflammable

The Purest, Most Rapid and Economical, Uniform, and Effective Case-Hardening Compound on the market for all kinds of Iron and Steel.

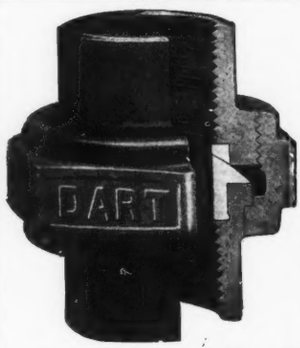
KASENIT No. 1	KASENIT No. 2	ANTI-CEMENTITE
For Fine Work and Very Rapid Hardening	For General Hardening	for Local Case Hardening.
Sold in ⅓ lbs., 1 lb., 3 lb., 5 lb., and 10 lb. tins	Sold in 25 lb., and 50 lb. kegs	Sold in 1, 5, 10 25 & 50 lb. lots.

Yours for the Asking

Write for FREE booklet "Open Hearth Hardening with Kasenit" valuable for its suggestions, recommendations, tables and other information for Open Hearth Hardening.

Ask Your Dealer or Write

KASENIT COMPANY
120 Liberty Street New York



TIGHT!

They stay that way. Dart Unions are made with bronze seats, and do not rust or corrode. On steam, water, oil and gas lines they are profitable investment because once in, they stay without leaks. Dart Unions often outlast two or three pipe installations. We also make Union Ells, Tees, etc. Sample on request.

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"HEAT-EASY" Compound

Prevents Scaling and Distortion in Hardening HIGH SPEED STEEL

Also, We Furnish Skilled Hardening Service of every kind with results absolutely guaranteed

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UNIFORM TEMPERATURE—MAXIMUM OUTPUT—MINIMUM FUEL COST.

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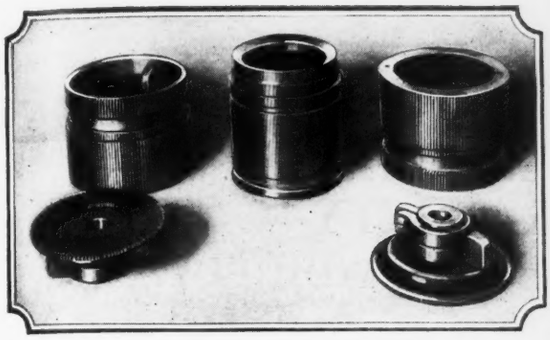
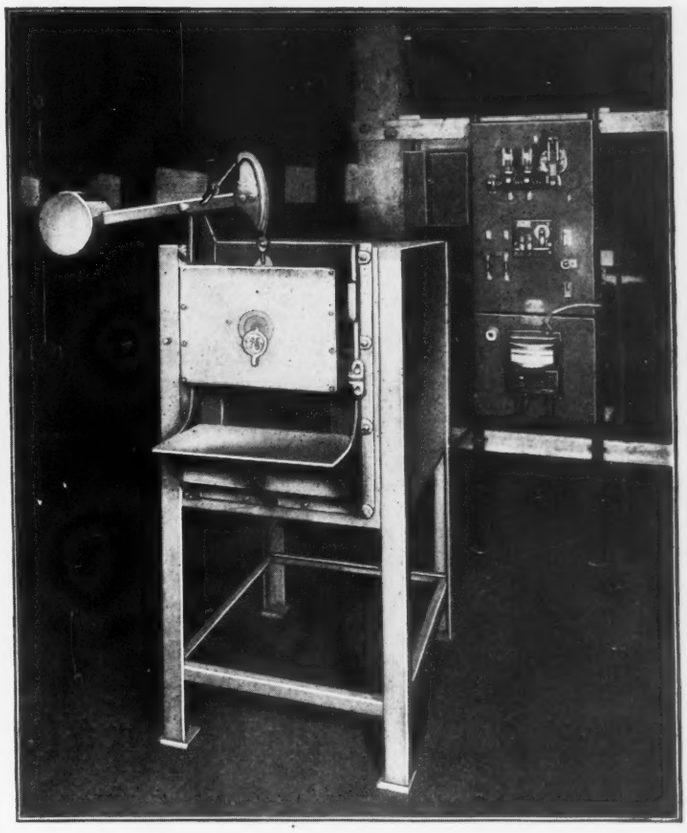


"We can't make these parts too good!"

The Fidelity Machine Co.



So a G-E Heat-Treating Furnace was Installed

Certain parts of textile and hosiery machines manufactured by the Fidelity Machine Co., of Philadelphia, are intricate and difficult to produce. Fashioned with exacting care from the finest of special steel, they exemplify a high state of perfection.

Material and workmanship could not be improved, but the heat-treating could. So a G-E heat-treating furnace was installed.

The parts are now distinctive in their uniform high quality; rejects are unknown; heat-treating is clean and comfortable; and customer appreciation is rapidly mounting.

There are countless machine parts and tools which though already of high quality, can be greatly improved by scientific heat-treating in clean, compact, well-built, G-E heat-treating furnaces.

Complete information supplied upon request to your nearest G-E sales office.

Although electric heat will not supplant all other forms of heat for industrial purposes, there are processes in every industry where it is the ideal heat—the most economical heat—the heat that ultimately will be used.

ULTIMATELY
ELECTRIC HEAT
IN EVERY INDUSTRY

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The Flexible Shaft

FLEXIBILITY
DURABILITY
PROFIT-making ABILITY
for the user

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"Take the tools to the work and leave the weight of the drive behind."

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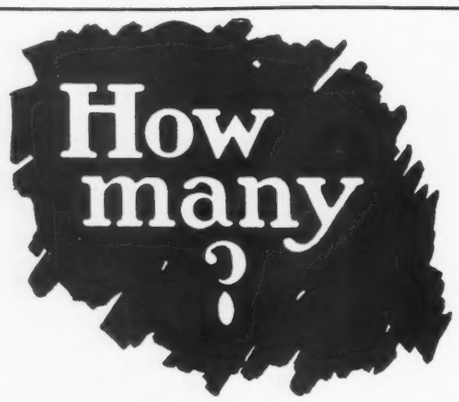

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Anything—
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PINTS OR GALLONS
PIECES OR INDIVIDUALS
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THAT IS THE RECORD WHICH A

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COUNTER

will give you, on any machine to which you attach it.

It is a wonderful individual census taker. Saves time—permits you to know the output of each machine or press—eliminates arguments—is a basis for paying.

May we send you our booklet on "The Root Counter"?

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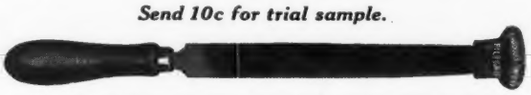
Safer, Cheaper Filing

Osgood Indestructible File Handles outlast many of the ordinary type. They are made with a steel tube running the length of the handle which takes the file tang, and distributes the pressure. They are also fitted with Osgood Can't Slip Ring which positively prevents the handle from coming off.

Protected with an Osgood Indestructible Handle and the Osgood Safety Filegrip, the file is 100% safe and 100% efficient. Try them both and watch production jump.

Send 10c for trial sample.



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Help This Man Win for You

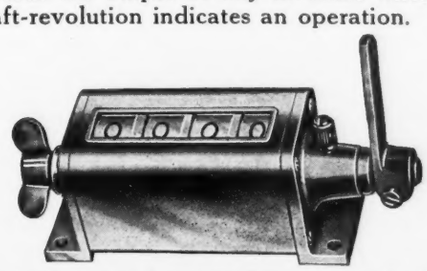
WHO is really the man of the hour in making your manufacturing *pay*—this competitive day?

He's the individual workman who cuts a few minutes from an hour's task!

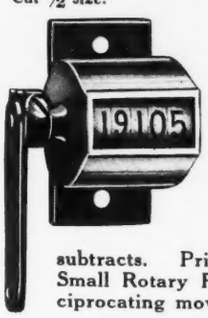
He's the man who works with accurate *records* of what his machine turns out. His task is measured, his progress figured, his gains "checked up" by the production records of

Veeder COUNTERS

The **Revolution Set-Back Counter** below records the output of any machine where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00—subject to discount. Large Set-Back **Rotary Ratchet Counter** for punch presses, etc., to count *reciprocating* movements, $11.50 (list). *Cut ½ size.*



The small **Revolution Counter** at left counts the output of the smaller machines, where the turn of a shaft means turning-out a unit of product. This counter, though small, is very durable; its mechanism will stand a very high rate of speed, such as required on many types of light machines. If run backward, the counter subtracts. Price, $2.00. (*Cut full size.*) Small Rotary Ratchet Counter, to count reciprocating movements, also $2.00.

You will see a "Veeder" for practically every machine in the Veeder booklet; you'll see how they speed up machine operators. Write for copy.

The Veeder Mfg. Co.

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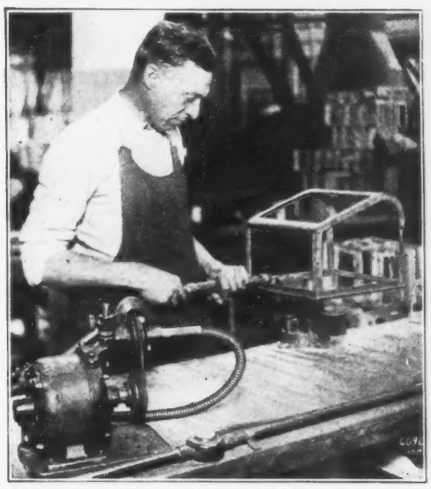
Only The Unafraid Say "Buy On Demonstration"



Light grinding operation with H-4 equipment.

THE manufacturer who is willing to pit his equipment against that of other manufacturers, or even against the actual shop conditions under which it must run, has the confidence — born of the knowledge of his product — that it will more than meet the work for which it is being tested.

FOR the work of grinding, filing, scraping, polishing, buffing, etc., a demonstration of Haskins Equipments gives us the opportunity of proving:

1. The ease of handling,
2. The quick tool set-ups and changes,
3. The adaptability to your plant conditions,
4. The accessibility of the tool to hard-to-get-at places, and
5. The superiority of Haskins Equipments over all other flexible shaft equipments.

BUT a short demonstration will hardly prove the length of life you can reasonably expect for average conditions. Let us give you complete information as to why you can expect Haskins Equipments to operate satisfactorily for a long period of time.

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With Shore's Scleroscope hardness tests may be made on any size or shape piece, without injury to the most highly finished objects, at the rate of more than 1000 tests per hour—500% greater than with any other type hardness tester.

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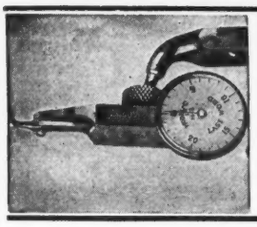

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Grind your drills to conform to the gage—59° angle between lip and axis—and you'll get the most work out of it, with the least effort. More than 59° means that the drill won't center; less than 59° means that it requires extra effort. Either way means poor work, broken drills, spoiled jobs and a lot of argument.

In most shops a No. 22 Drill Gage will pay for itself in a mighty short time. Better ask your dealer to show you one.

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THE L. S. STARRETT CO.
World's Greatest Toolmakers
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Steel Tapes—Standard for Accuracy
ATHOL, MASS.

2

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Model 2-G

ROCKWELL DIRECT READING HARDNESS TESTER

This machine is used the world over because it is accurate, speedy and adaptable to a wide variety of shapes and sizes of material to be tested.

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Reads over a range of 0.055"—at a glance. Dial may be set at zero after adjusting to work. Contact point can be locked in position for inspecting. Keep it in your pocket and use it anywhere. Details?

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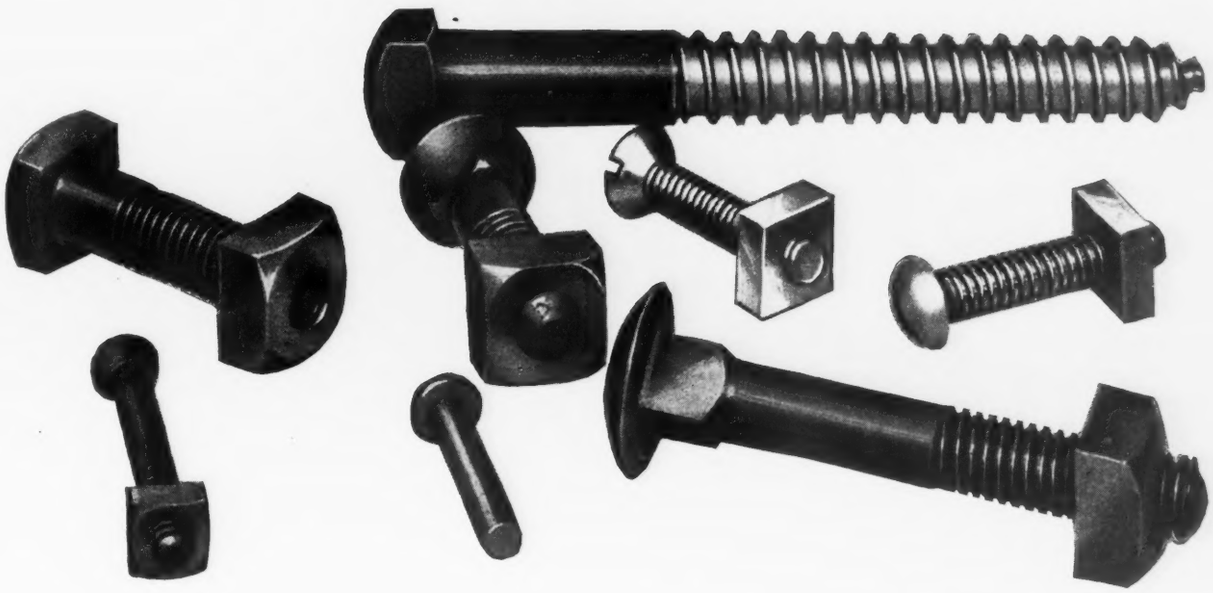

Uniform in Strength and Accuracy

Life may need uncertainty to give it spice and color—but not so a bolt.

Uniformity in excellence is the cardinal virtue in the manufacture of bolts and nuts.

Empire bolts, even under the usual method of threading, have always shown a uniformity of accuracy and strength unusual with production in such enormous quantities. But threaded on the New Process dies, they show in undeviating uniformity a degree of accuracy almost unbelievable and a strength 20% greater than the ordinary bolt.

And Empire nuts are uniformly a "fitting" match for them.

We will gladly send samples to confirm these statements.

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Read what they say about Mac-it screws:

"Most satisfactory that my millwright has ever used."

"These screws have always proved satisfactory, and we intend to keep right on using them."

"These screws have given us better service than any set screws we have ever been able to secure. The expense in labor in drilling out screws that had been twisted off, alone justifies the slight additional cost over ordinary screws."

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THE STRONG, CARLISLE & HAMMOND CO.

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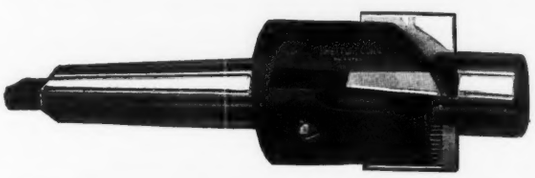
O.K. Tools for LATHES, SHAPERS, PLANERS, BORING MILLS, AUTOMATICS, SPECIAL MACHINES, MILLING MACHINES

Adjustable Counterbores



Another high production, low cost O.K. Tool is the Inserted Tooth Counterbore. Teeth are of high speed steel especially hardened and treated to give exceptionally long and efficient cutting service. They are securely held and can be adjusted outward in steps of 0.005", so that the correct outside diameter is maintained. The teeth can be replaced at about a fifth the cost of the whole counterbore. Bodies wear indefinitely, and new pilots may be secured when needed.

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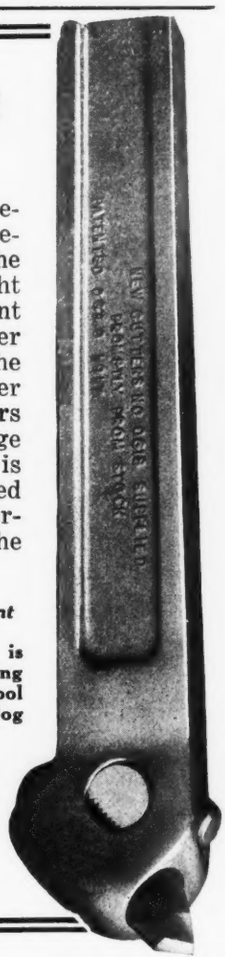
The Inserted Cutters of Lovejoy Lathe Tools are held securely and presented to the work at exactly the right angle for the most efficient cutting. Cutter and holder are separate units so that the most suitable steel and temper for each can be used. Cutters therefore hold their edge longer and tool breakage is greatly lessened. When used up, new cutters can be purchased for a fraction of the cost of a whole tool.

Efficient Metal Cutting Equipment

The Lovejoy Locking Principle is applied to Lathe Tools, Boring Heads, Milling Cutters, Turret Tool Posts. May we send you a catalog describing them?



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Makes fine lines for

Figuring
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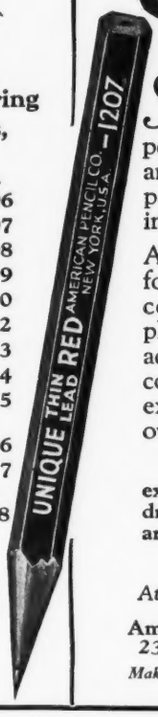
Price $1.00 *per doz.*



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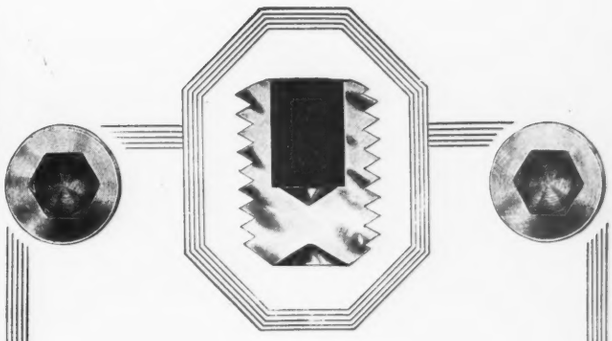

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These are the things you want in your Hollow Screws—without wanting to order all details:

More strength than the ordinary broached hollow screw; 30% more by test;

Deep, true, wrench-fitting sockets; hexagon holes for fast, firm assembly;

Special-analysis alloy steel, heat-treated as each screw requires, to develop maximum durability;

Accurate threading, so the screws won't loosen under vibration in moving parts.

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Puts the figures at your finger tips!
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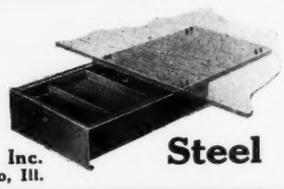
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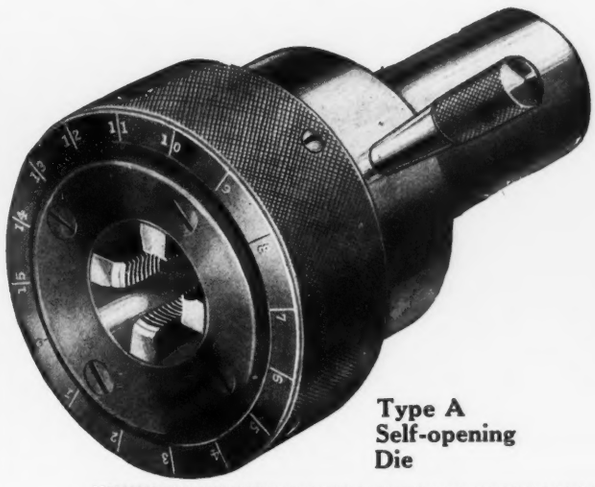

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Send blueprints of your threading operations—our engineers will indicate the tool that will enable you to get most profitable results.

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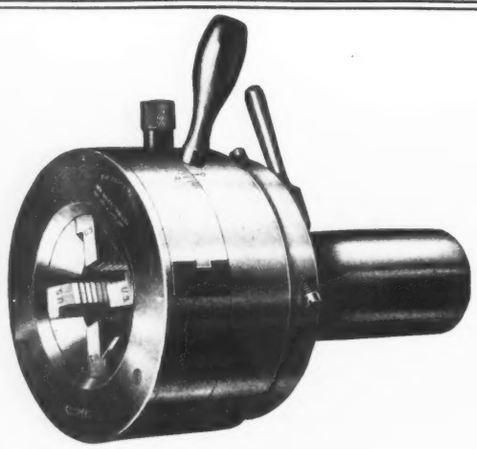
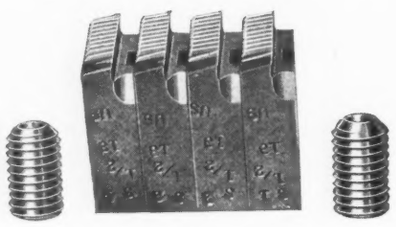


26,200 Threads

In Cold Rolled Screw Stock



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We have studied steel, hardening, grinding, and every condition of Thread Chaser making, that we may offer you Chasers of longest possible life.

That is why Geometric Chasers can tackle hard stock and stand up under it.

Men experienced in Screw Thread Production know there is no better method than

Geometric Die Heads
Collapsing Taps, Threading Machines

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New Haven, Conn., U. S. A.

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Madison Boring Bars will cut the cost and improve the accuracy of your bored holes. In one instance, at the Battle Creek, Mich., plant of the Advance, Rumely Corporation where they make steel pinions in which holes 1⅜" diameter by 6" deep must be bored, Madison Boring Bars were put on the job and they averaged 1200 holes per grind. This was an increase of 400 per cent over their old production, as the best they could get from any other boring tool in stock was 300 holes per grind. This is a typical example of the efficiency of Madison Boring Bars.

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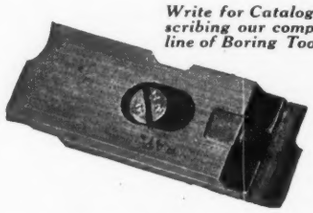

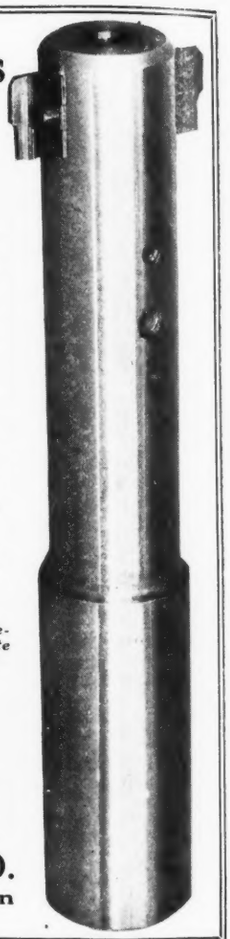

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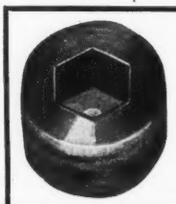

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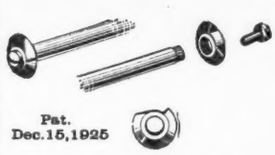

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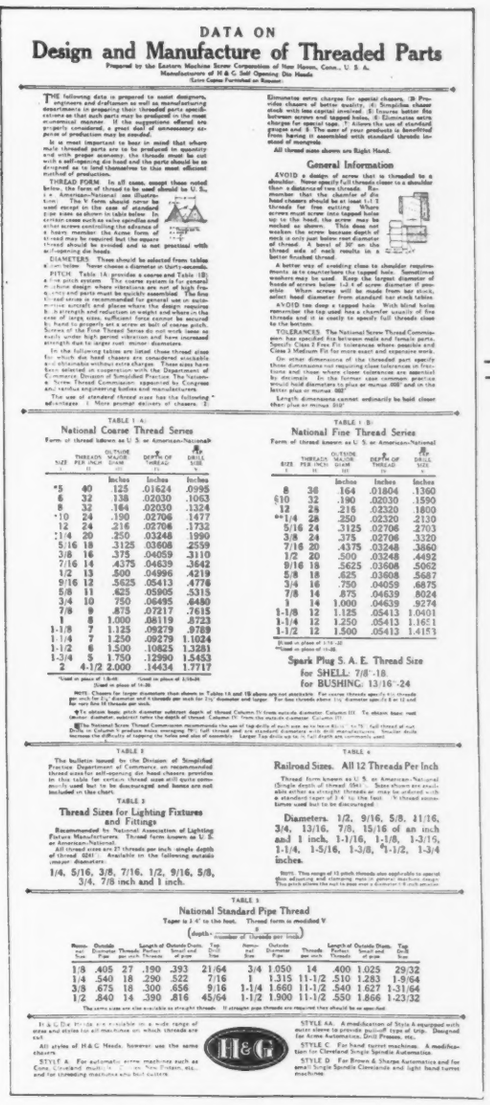
Without Cost or Obligation

With this chart (13″ x 29″) before them your engineers and draftsmen will be able to design threaded parts for any product according to standards established and recommended by the Division of Simplified Practice of United States Department of Commerce, under the direction of Mr. Herbert Hoover; the National Screw Thread Commission appointed by Congress; and various bodies of engineers and manufacturers.

This chart enables designers, engineers and draftsmen as well as production departments to prepare their threaded part specifications so that such parts may be produced in the most economical manner.

Send for as many copies as you can profitably use. Absolutely no charge or obligation. Please use business letterhead.



DATA ON

Design and Manufacture of Threaded Parts

Prepared by the Eastern Machine Screw Corporation of New Haven, Conn., U. S. A.
Manufacturers of H & G Self Opening Die Heads
(Extra Copies Furnished on Request)

THE following data is prepared to assist designers, engineers and draftsmen as well as manufacturing departments in preparing their threaded parts specifications so that such parts may be produced in the most economical manner. If the suggestions offered are properly considered, a great deal of unnecessary expense of production may be avoided.

It is most important to bear in mind that where male threaded parts are to be produced in quantity they should, for proper economy, the threads must be cut with a self opening die head and the parts should be so designed as to lend themselves to this most efficient method of production.

THREAD FORM. In all cases, except those noted below, the form of thread to be used should be U. S., i. e. American-National see illustration. The V form should never be used except in the case of standard pipe sizes as shown in table below. In certain cases such as valve spindles and other screws controlling the advance of a heavy member, the Acme form of thread is recommended but the square thread should be avoided and is not practical with self-opening die heads.

DIAMETERS. These should be selected from tables as noted below. Never choose a diameter at short decimals.

PITCH. Table 1A provides a coarse and Table 1B a fine pitch for each diameter of bolt or screw. For machine design where vibrations are apt to occur, nuts and parts must be quickly assembled, the fine thread series is recommended for general use or automotive aircraft and places where the design requires high strength and reduction in weight and where in the case of large sizes, sufficient force cannot be secured by hand to properly set a screw or bolt of coarse pitch. Screws of the Fine Thread Series do not work loose as readily from jars or general vibration and have increased strength due to smaller minor diameters.

In the following tables are listed those thread sizes for which die head chasers are considered available without extra charge. These sizes have been selected in cooperation with the Department of Commerce, Division of Simplified Practice. The National Screw Thread Commission appointed by Congress and various engineering bodies and manufacturers.

The use of standard thread sizes has the following advantages. 1. More prompt delivery of chasers. 2. Eliminates extra charges for special chasers. 3. Provides chasers of better quality. 4. Simplifies chaser stock with less capital involved. 5. Insures better fits between screws and tapped holes. 6. Eliminates extra charges for special taps. 7. Allows the use of standard gauges and 8. The user of your products is benefitted from having it assembled with standard threads instead of mongrels.

All thread sizes shown are Right Hand.

General Information

AVOID a design of screw that is threaded to a shoulder. Never specify full threads very close to a shoulder than a distance of two threads. Remember that the chamfer of die head chasers should be at least 1-1 threads far free cutting. Where screws must screw into tapped holes up to the head, the screw may be reached as shown. This does not weaken the screw because depth of thread in tapped hole is greater than of thread. A bevel of 30° on the thread side of each results in a better finished thread.

A better way of avoiding close to shoulder requirements is to countersink the tapped hole. Sometimes washers may be used. Keep the largest diameter of heads of screws below 1-4 of screw diameter if possible. When screws will be made from bar stock, select head diameter from standard bar stock tables.

AVOID too deep a tapped hole. With blind holes remember the tap used has a chamfer usually of five threads and it is costly to specify full threads close to the bottom.

TOLERANCES. The National Screw Thread Commission has specified for between male and female parts, Specific Class 2 Free Fit tolerances where possible and Class 3 Medium Fit for more exact and expensive work.

On other dimensions of the threaded part specify those dimensions not requiring close tolerances in fractions and those where closer tolerances are essential by decimals. In no case can commercial practice hold diameters to plus or minus .002" and on the latter plus or minus .001"

Length dimensions cannot ordinarily be held closer than plus or minus .010"

TABLE 1-A:
National Coarse Thread Series
Form of thread known as U. S. or American-National

SIZE	THREADS PER INCH n	OUTSIDE OR MAJOR DIAM D	DEPTH OF THREAD .6495/n	DRILL SIZE
		Inches	Inches	Inches
*5	40	.125	.01624	.0995
6	32	.138	.02030	.1063
8	32	.164	.02030	.1324
*10	24	.190	.02706	.1477
12	24	.216	.02706	.1732
1/4	20	.250	.03248	.1990
5/16	18	.3125	.03608	.2559
3/8	16	.375	.04059	.3110
7/16	14	.4375	.04639	.3642
1/2	13	.500	.04996	.4219
9/16	12	.5625	.05413	.4776
5/8	11	.625	.05905	.5315
3/4	10	.750	.06495	.6480
7/8	9	.875	.07217	.7615
1	8	1.000	.08119	.8723
1-1/8	7	1.125	.09279	.9789
1-1/4	7	1.250	.09279	1.1024
1-1/2	6	1.500	.10825	1.3281
1-3/4	5	1.750	.12990	1.5453
2	4-1/2	2.000	.14434	1.7717

*Used in place of 1-8-32. †Used in place of 1-20-20. ‡Used in place of 1-20-28.

TABLE 1-B:
National Fine Thread Series
Form of thread known as U. S. or American-National

SIZE	THREADS PER INCH n	OUTSIDE OR MAJOR DIAM D	DEPTH OF THREAD .6495/n	DRILL SIZE
		Inches	Inches	Inches
8	36	.164	.01804	.1360
§10	32	.190	.02030	.1590
12	28	.216	.02320	.1800
**1/4	28	.250	.02320	.2130
5/16	24	.3125	.02706	.2703
3/8	24	.375	.02706	.3320
7/16	20	.4375	.03248	.3860
1/2	20	.500	.03248	.4492
9/16	18	.5625	.03608	.5062
5/8	18	.625	.03608	.5687
3/4	16	.750	.04059	.6875
7/8	14	.875	.04639	.8024
1	14	1.000	.04639	.9274
1-1/8	12	1.125	.05413	1.0401
1-1/4	12	1.250	.05413	1.1651
1-1/2	12	1.500	.05413	1.4153

§Used in place of 1-10-32. **Used in place of 1-14-28.

Spark Plug S. A. E. Thread Size
for SHELL: 7/8"-18.
for BUSHING: 13/16"-24

NOTE: Chasers for larger diameters than shown in Tables 1A and 1B above are not stockable. For coarse threads specify 4½ threads per inch for 2½" diameter and 4 threads per inch for 3½" diameter and larger. For fine threads above 1¼" diameter use 5½ for 1¾ and for very fine 14 threads per inch.

◆To obtain basic pitch diameter subtract depth of thread Column IV from outside diameter Column III. To obtain basic root diameter subtract subtract twice the depth of thread Column IV from the outside diameter Column III.

The National Screw Thread Commission recommends the use of top-ability of each size as to base fillet. To full thread at root. Refer to Column V number which designates the percentage 75% full thread which are standard diameters with drill manufacturers. Smaller drills increase the difficulty of tapping the holes and also of assembly. Larger Tap drills up to ¾ full depth are commonly used.

TABLE 2
The bulletin issued by the Division of Simplified Practice Department of Commerce, on recommended thread sizes for self-opening die head chasers provides in this table for certain thread sizes still quite commonly used but to be discouraged and hence are not included on this chart.

TABLE 3
Thread Sizes for Lighting Fixtures and Fittings
Recommended by National Association of Lighting Fixture Manufacturers. Thread form known as U. S. or American-National.
All thread sizes are 27 threads per inch single depth of thread .0241 inch. Available on the following outside diameters:
1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 3/4, 7/8 inch and 1 inch.

TABLE 4
Railroad Sizes. All 12 Threads Per Inch
Thread form known as U. S. or American-National (Sharp depth of thread .0541 inch). Sizes shown are available in stock but others as may be ordered with a standard taper of 3-4" to the foot. V thread construction used but to be discouraged.
Diameters. 1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16 of an inch and 1 inch, 1-1/16, 1-1/8, 1-3/16, 1-1/4, 1-5/16, 1-3/8, 1-1/2, 1-3/4 inches.
NOTE. This range of 12 pitch threads also applicable to special thin adjusting and clamping nuts in general machine design. This pitch allows the nut to have over a diameter 1-8 each section.

TABLE 5
National Standard Pipe Thread
Taper is 3-4" to the foot. Thread form is modified V.
$n = \frac{8}{\text{depth} \times \text{number of threads per inch}}$

Nominal Size	Outside Diameter Pipe	Threads per inch	Length of Perfect Threads	Outside Diam. Small end of pipe	Tap Drill Size	Nominal Size	Outside Diameter Pipe	Threads per inch	Length of Perfect Threads	Outside Diam. Small end of pipe	Tap Drill Size
1/8	.405	27	.190	.393	21/64	3/4	1.050	14	.400	1.025	29/32
1/4	.540	18	.290	.522	7/16	1	1.315	11-1/2	.510	1.283	1-9/64
3/8	.675	18	.300	.656	9/16	1-1/4	1.660	11-1/2	.540	1.627	1-31/64
1/2	.840	14	.390	.816	45/64	1-1/2	1.900	11-1/2	.550	1.868	1-23/32

The same sizes are also available as straight threads. If straight pipe threads are required they should be so specified.

H & G Die Heads are available in a wide range of sizes and styles for all machines on which threads are cut.

All styles of H & G Heads, however use the same chasers.

STYLE A. For automatic screw machines such as Cone, Cleveland multiple [illegible], New Britain, etc., and for threading machines and bolt cutters.

STYLE AA. A modification of Style A equipped with outer sleeve to provide pullstiff type of trip. Designed for Acme Automatics, Davis Presses, etc.

STYLE C. For hand turret machines. A modification for Cleveland Single Spindle Automatics.

STYLE D. For Brown & Sharpe Automatics and for small Single Spindle Cleveland and light hand turret machines.

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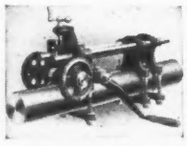

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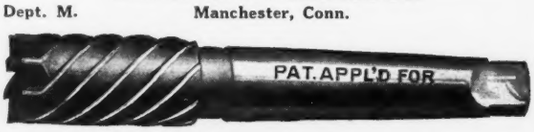

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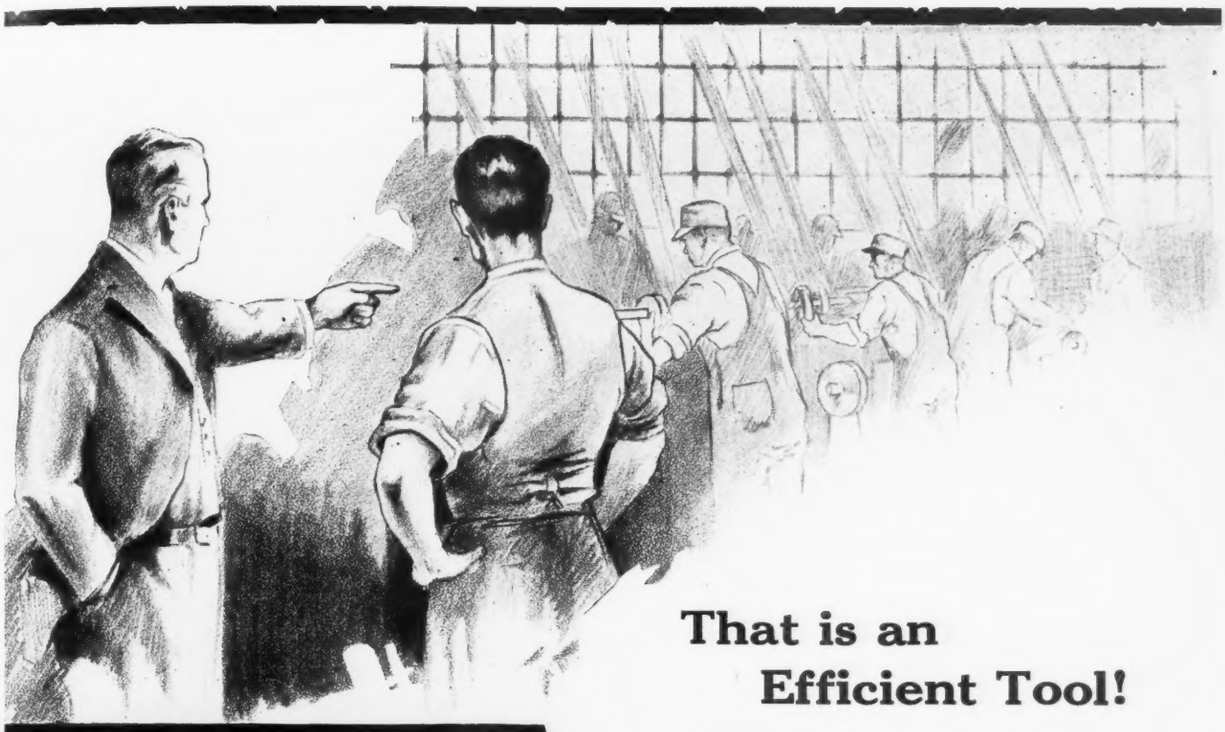

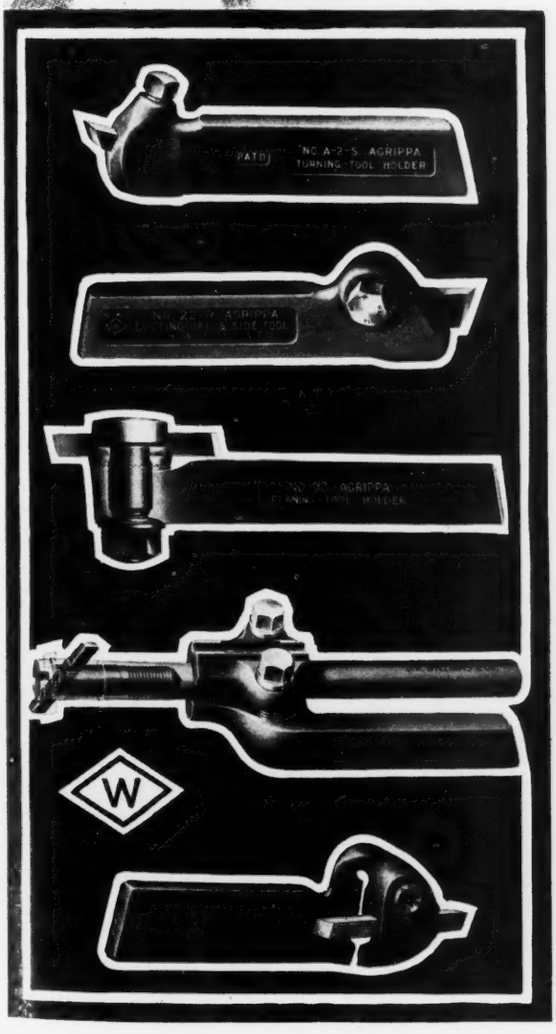

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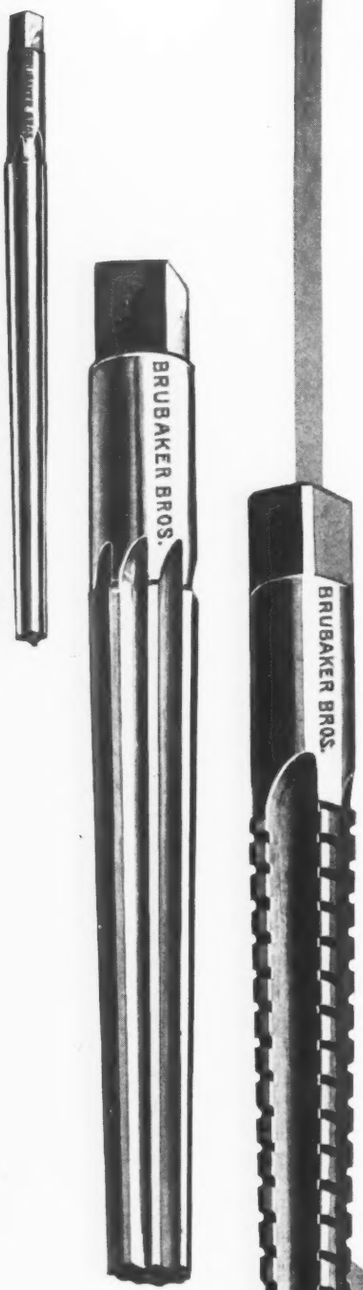

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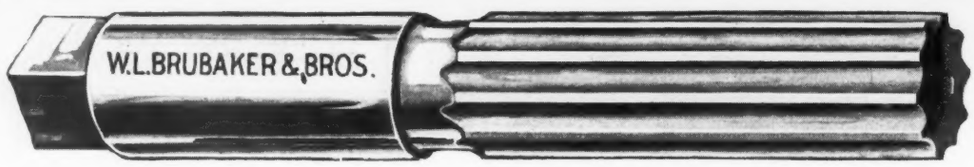

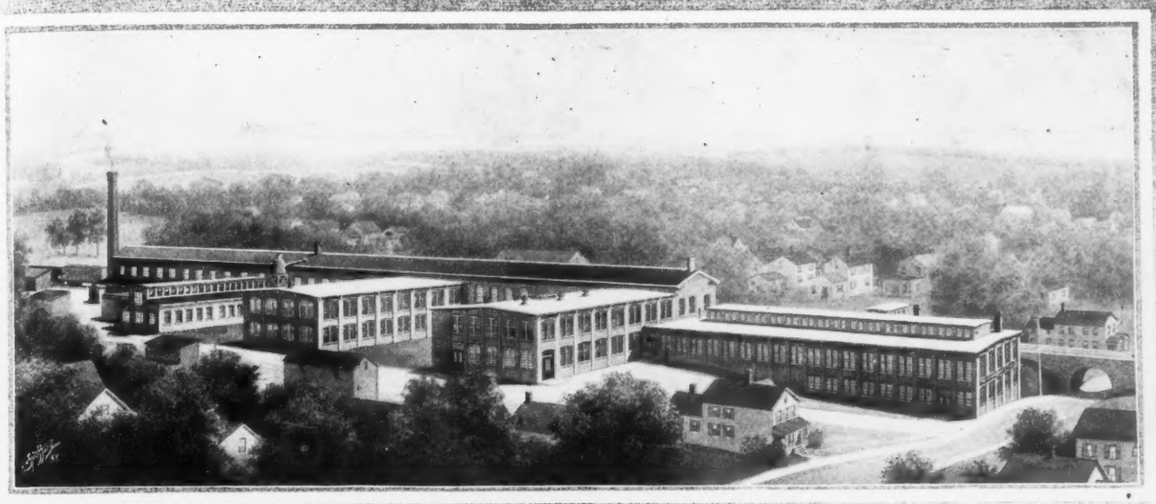

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This plant and the major part of Threadwell facilities are devoted to the making of taps and dies to highest standards and providing a consulting service that makes the purchase of Threadwell Threading Tools a paying investment.

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Greenfield, Mass.

1323 Dime Bank Bldg. . Detroit, Mich.	18 S. Clinton St. . . . . Chicago, Ill.
135 St. Clair Ave., N. E. . Cleveland, O.	604 Mission St. . . San Francisco, Cal.
809 Harrison Bldg. . . Philadelphia, Pa.	246 St. Paul St. . . . Rochester, N. Y.
Bessemer Building . . . Pittsburgh, Pa.	130 South Penn St. . . Indianapolis, Ind.
1410 Porter St. . . . Richmond, Va.	

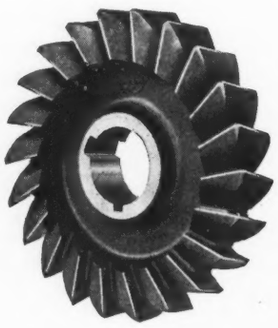
THREADWELL

TAPS—DIES—SCREW PLATES AND SMALL TOOLS

One of several machine rooms at the Threadwell Plant.

Final inspection of Threadwell Tools.

A small part of the stock room for finished tools.



TOOLS THAT GO AND GO

MADE IN

GD & GD DETROIT, MICH. U.S.A.

TRADE MARK. REG U S PAT OFF

WE WILL EXHIBIT NATIONAL STEEL & MACHINE TOOL EXPOSITION CHICAGO MUNICIPAL PIER SEPT 20-24 BOOTH NO. 211-215

GODDARD & GODDARD COMPANY

DETROIT

MILLING CUTTER ENGINEERS

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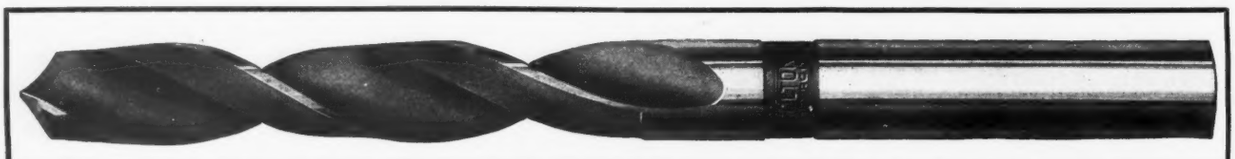


It's Inevitable - -

When you try Colton-Detroit High Speed Twist Drills it is inevitable that you will accept them as standard equipment for your shop. Their ability to stand up under high speeds and heavy feeds through the toughest metals will convince you of their value on your work.

Colton-Detroit High Speed Drills are made with unusual refinement of the steel in the web and flute, assuring exceptional cutting qualities of the point and lips, and producing the greatest number of clean, smooth holes between point grindings.

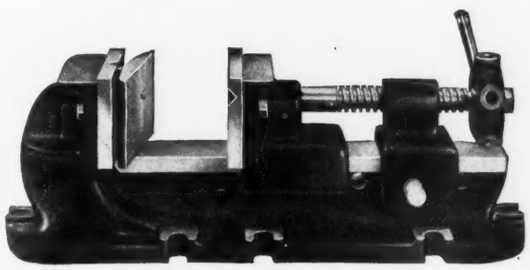
Immediate delivery can be made of all regular size drills from our complete stock.

Colton "Specials" used exclusively in many of the largest plants give maximum, satisfactory service at the lowest cost. Always glad to quote prices and delivery.

ARTHUR COLTON CO., 2618 Jefferson Avenue, East Detroit, Mich

REPRESENTATIVES: **New York City:** F. A. Brady, Inc., 30 Church St. **Milwaukee:** General Sales Agency, 3205 Vine St. **Pittsburgh:** Samson Tool & Machine Co., 6129 Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Co., 745 North Sixty-third St. **San Francisco:** L. G. Henes, 75 Fremont St. **Los Angeles:** L. G. Henes, 1418 Santa Fe Ave. **Cincinnati:** Advance Tool Co., Canal and Jackson Sts.

THE GEM DRILL PRESS VISE



Made in 3 sizes up to 10½';—send for circular and price list.

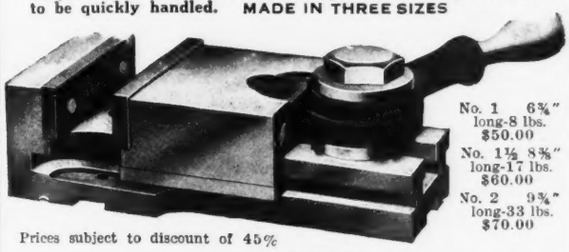
Drilling can be put on a new production basis by installing Gem Drill Press Vises. The swivel jaw quickly and automatically adjusts itself to tapered and odd shaped work, the V grooves in both jaws hold work firmly in either vertical or horizontal positions.

More time is allowed for actual production, when the drill press is equipped with a Gem—it reduces setting up time.

J. E. Martin Tool & Die Works
548 West State Street, SPRINGFIELD, OHIO

The Pronto Quick Operating and Wide Opening Lever Vises

Designed for Milling and Drilling Machines and is especially adapted for any work where a large number of pieces are to be quickly handled. MADE IN THREE SIZES



No. 1 6¾" long-8 lbs. $50.00
No. 1½ 8⅜" long-17 lbs. $60.00
No. 2 9¾" long-33 lbs. $70.00

Prices subject to discount of 45%

MANUFACTURED BY
EDW. PURVIS & SON
110 YORK ST. successors to CARTER & HAKES BROOKLYN, N. Y.

Angle Work Without Special Fixtures

For drilling holes, milling or planing at various angles on a single piece, the Boston Universal Angle Plate is ideal. Clamp the work to the Plate, and without further setting it can be moved through 360° horizontally and 120° vertically and locked in position within an accuracy of 5 minutes. Saves hours of time and replaces many expensive special fixtures.

Let us send catalog.

Boston Scale & Machine Company
100 Ruggles St., Boston, Mass.
Agents for Great Britain, Belgium, Italy, India, Burmah and Ceylon, Japan, Formosa and Korea, Alfred Herbert, Ltd., Coventry, Eng.

The DANGER of not having enough

VISES

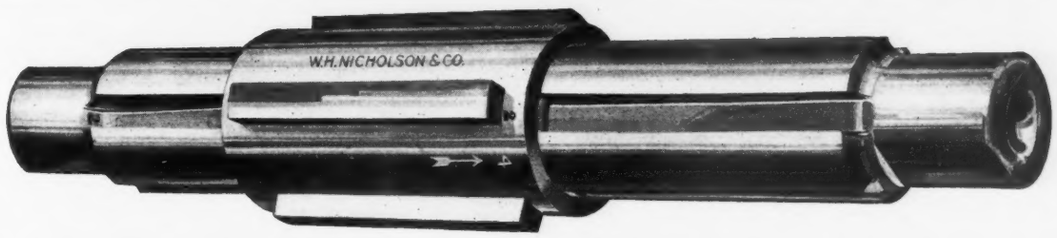
"Not enough" means that workers will often have to leave their working stations and go to some distant point to use a vise. Often they have to WAIT for a vise to be vacated, or make a second trip. Possibly they stop and talk to other workers on the way "out" and on the way "back"—two idle instead of one. Put a

REED VISE

right at the work station of every worker who has even but occasional use for one and you will save money.

Reed Manufacturing Co., Erie, Pa.

Send for BOOKLET explaining the superiority of "Reed" Guaranteed throughout.



A job can be placed so it overhangs the jaws on this mandrel, which permits the facing down of the side without the turning tool damaging the mandrel. You cannot do this on a solid mandrel. Write us for further information and prices.

W. H. NICHOLSON & CO., 114 Oregon Street, Wilkes-Barre, Pa.

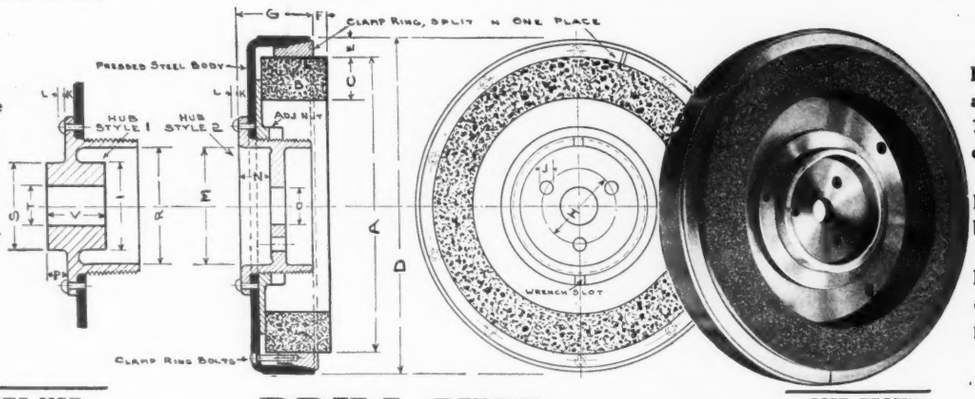
Pressed Steel Bodies
For Holding Abrasive Rings,
Wet or Dry Grinding.

GRINDER CHUCKS

3000 in Use.
Hubs to Suit All Kinds of
Spindles and Machines.

For use on

Disc, Floor, Knife, Guide Bar, Pulley, Safe-Plate Edge, and Special Grinders, or any place where face grinding is done.



Nine Sizes

Holding solid abrasive rings 10" to 30" diameter

In a class by themselves

Make your disc grinder profitable.

DRILL VISE

ITS USE

A good one for your driller, miller, shaper or planer.

The attachments mean that you can do much duplicate drilling without the cost of a jig.

Any vise will pay. More time is consumed in catching work than drilling it.

LIST PRICES

No. 3, Jaws 6" long, with attachments, $45.00, without $40.00
No. 4, Jaws 9" long, with attachments, $60.00, without $54.00
No. 5, Jaws 12" long, with attachments, $85.00, without $75.00
V-Jaws extra, No. 3, $5.00; No. 4, $7.50; No. 5, $10.00 each.
One V-Jaw is usually sufficient per vise.

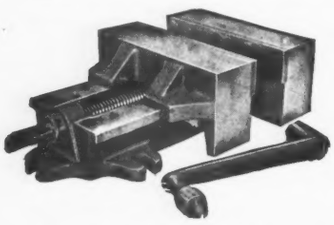


Fig. 2. Without Jig Attachments

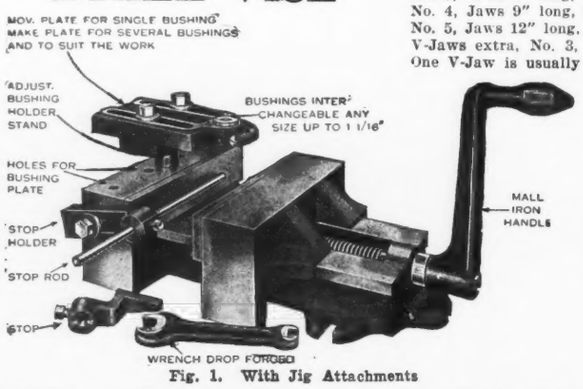


Fig. 1. With Jig Attachments

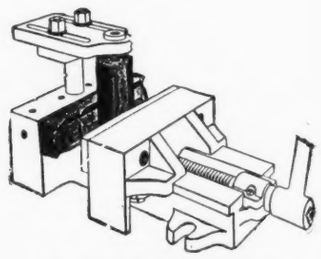
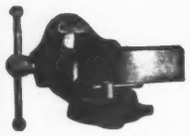


Fig. 3. V-Jaw for Round Work

THE GRAHAM MFG. COMPANY
71 Willard Ave., Providence, R. I.

Great Britain—Richard Lloyd & Co., Ltd., Birmingham.
France, Italy, Switzerland, Spain and Holland—Fenwick Freres & Co.
Germany—A. Kayser, Oranienstrasse, 126, Berlin.



YOST VISES

for every need

Yost Vises are designed and constructed to exactly meet the needs of the modern machine shop—vises that will hold fast until released. They are made of a special composition metal of exceptional toughness to stand the hard usage that is bound to come daily to a tool of this kind.

Yost designers keep Yost Vises up to the requirements of the modern machine shop; —stock vises can be had for every standard need. "Specials" made to order for exceptional uses. Every Yost Vise is fully guaranteed.

The Yost Line includes Stationary, Adjustable, Saw, Swivel Vises, also Drill Press, Pipe Vises, Anvils, etc.

Send for Our Catalog.

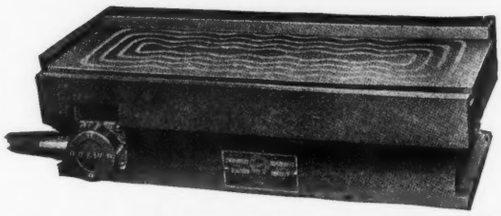
YOST MANUFACTURING CO.
MEADVILLE, PA.

SWEETLAND CHUCKS

Heavy cuts and hard pulls can't loosen work when it is gripped in a Sweetland Chuck. Made with reversible jaws with universal or independent action. Sizes 6" to 24" in 3" steps to 42" in 6" steps.

Ask for Catalog 13-C

THE HOGGSON & PETTIS MFG. COMPANY
NEW HAVEN, CONNECTICUT



D & W MAGNETIC CHUCKS

An extended line of flat and rotary chucks with a variety of attachments to convert flat chucks into vertical, taper or swiveling types as required. Let us send circular and complete information.

J. & H. ELECTRIC CO.
161 Clifford Street **PROVIDENCE, R. I.**

The "PROCUNIER"

"Double Jaw" Quick Change Chucks

Change your machine to a semi multiple —use a "Procunier" "Double Jaw" Quick Change Chuck with a collet for every tool. The Pep Spring speeds collet changes, and insures a non-slip grip.

Catalog M for complete details of "Procunier" Tapping Devices, Quick-Change Chucks and Stud Setting Tools.

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18 So. Clinton St., CHICAGO, ILL.

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Main office and works:
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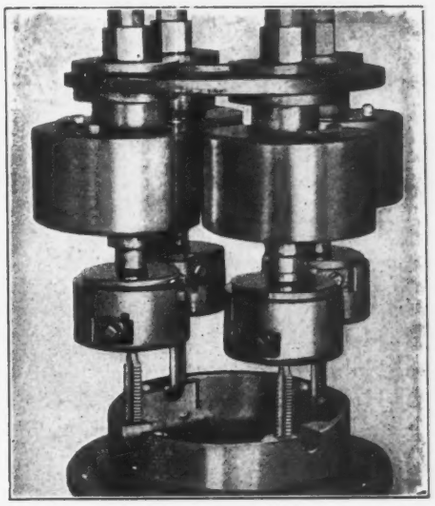
Chicago Office:
612 W. Adams Street

Catalog Francais: Edgar Bloxham Paris 12 Rue du Dei

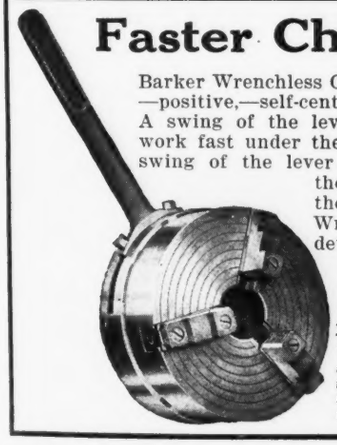
Also Multiple Tapping Heads for Single Spindle Drill Press.



ERRINGTON TAPPERS reduce tapping costs to the minimum, insure exact duplication of work, are simple, compact and long wearing. Taps up to 5/8" can be used with only 2 1/4" between centers, and larger sizes are proportionately compact. In the job shown in the engraving 2560 3/8" holes were drilled and tapped in malleable iron gear cases in eight hours. Let us figure on your line of tapping.

Errington Opening Die-heads; Collapsing Taps; Opening Stud-setter; Friction Stud; Nut and Screw-drivers, etc.

Faster Chucking

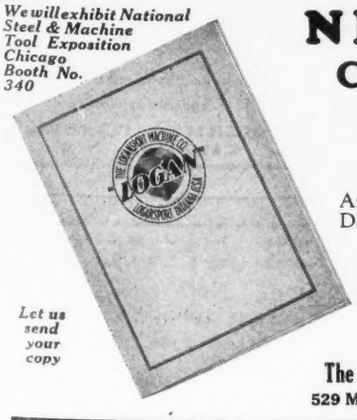


Barker Wrenchless Chucks are quick, simple, —positive,—self-centering and sure gripping. A swing of the lever grips and holds the work fast under the heaviest cuts—another swing of the lever releases it. Wherever there is a production job there is work for a Barker Wrenchless Chuck—ask for details.

Thomas Elevator Co.
(Chuck Division)
24 So. Hoyne Ave., Chicago

The BARKER Wrenchless Chuck was developed and is manufactured in the Chuck Division of Thomas Elevator Company—a separate department maintained for this single purpose.

We will exhibit National Steel & Machine Tool Exposition Chicago Booth No. 340



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NEW!

Catalog R 22 Just Out

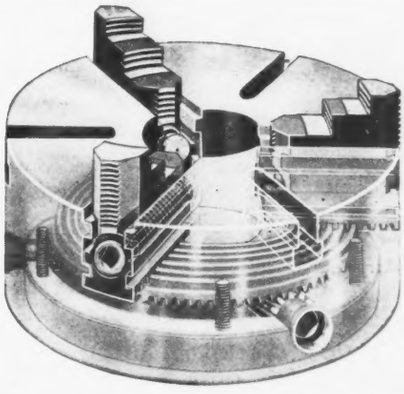
"LOGAN"

Air Operated Labor Saving Devices.

Chucks Presses Cylinders Work Ejectors, etc.

Greater Economy—Multiplied Production.

The LOGANSPORT MACHINE CO.
529 Market Street, Logansport, Ind.



The Union No. 83 Combination Chuck

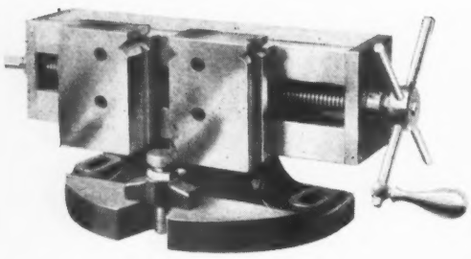
One chuck that will give you the same service as two—a rigid Independent Jaw Chuck or an equally efficient Universal Jaw Chuck—as you desire. Easily and quickly changed from one type to another—effecting big savings in set-up time. 3 or 4 jaws, easily removed, changed or adjusted—a genuine production booster.

Send for complete catalog of Union Chucks

Union Manufacturing Co.
Makers of a Complete Line of Chucks
NEW BRITAIN CONN., U. S. A.

BRANCH OFFICES WHERE STOCK IS CARRIED:

New York, 26 Cortlandt St. Cincinnati, 806 Sycamore St.
Chicago, 25 So. Jefferson St. San Francisco, 770 Folsom St.



Saved $1200
in Equipment alone!

A MANUFACTURER figured that special jigs to drill and ream forty different parts would cost $1800. He bought a John No. 2 Universal Vise Chuck to do the work, and his expenditure for jaws, bushings and chuck totaled $600. There's a clear saving of $1200.

The John Universal Vise Chuck and equipment was on the job, saving money, in a fraction of the time required to build the special jigs. There's another saving.

As for production—this manufacturer says "For a large run of small parts, the John Universal Vise-Chuck cannot be beat".

These are facts and figures—net. Worth thought and *action*. For example—ask us for sizes and prices of John Universal Vise Chucks.

BARBER-COLMAN PRODUCTS

Hobs
Hobbing Machines
Hob Sharpening Machines
Milling Cutters
Tapping Attachments
Universal Vise Chucks

WE WILL EXHIBIT
NATIONAL STEEL & MACHINE TOOL EXPOSITION
CHICAGO
MUNICIPAL PIER SEPT 20 TO 24
BOOTH
338

BARBER-COLMAN COMPANY
General Offices and Plant
Rockford, Ill., U.S.A.

The NEUDECK

Patented
Full-Automatic
Quick Change
Self-Centering
Self-Tightening
Dependable
Long-Life

DRILL CHUCK

A Marvelous Development in Chuck Construction

Eliminates all Chuck troubles.
Avoids breakage of Drills.
Saves time.
Increases production.

Insert or remove drills instantaneously without stopping or slowing the machine.

Unfailing Easy Release no matter what speed or load.
Slipping of Drill **Impossible**
No Scoring of Drill Shank.
Fully Guaranteed

Agents and Distributors Wanted

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250 West Broadway
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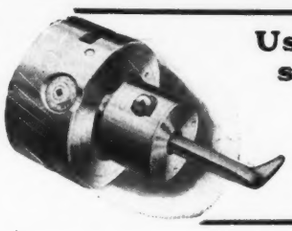
CUSHMAN LATHE CHUCKS

There is so much to tell about our Chucks as we build them to-day that in no less space than that of our Latest Catalog can we even approach doing justice to them.

SHALL WE SEND YOU CATALOG NO. 42 ?

The Cushman Chuck Company
Hartford, Conn.



Use the Casler Offset Boring Head

To reduce the cost of jigs and fixtures and the Casler Twin Screw Drill Chuck to reduce manufacturing costs.

Send your inquiries to

HERMAN CASLER
Canastota, N. Y.

LAVOIE AIR CHUCKS

See them in operation! Note speed and simplicity and you'll want them for your chucking. May we send the booklet?

The Frontier Chuck and Tool Co., Inc.
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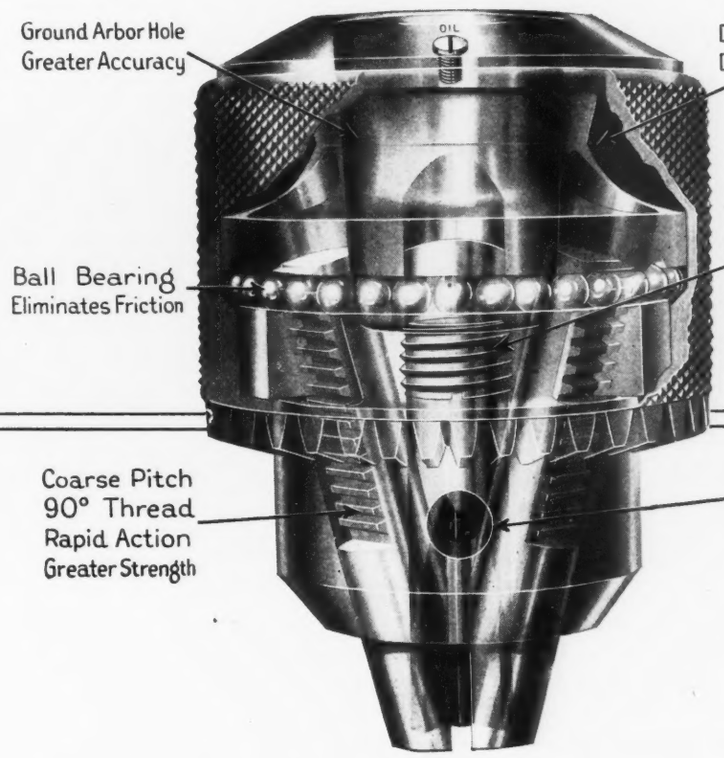
The New Jacobs Super Chuck

Outwears Others Three to One

One piece case hardened body ground to within half a thousandth, fundamentally correct and convenient design and ball bearing construction—here is the secret of the perfect mechanical balance that makes Jacobs Super Chucks not only exceptionally efficient in operation but remarkably durable.

Jacobs Super Chucks for the Drill Press, Tapping Machine, Lathe or Screw Machine. Send for details.



THE JACOBS MANUFACTURING COMPANY

HARTFORD, CONN.

The world's largest producers of "Drill Chucks"

When You Want a Spring

of any size—any length—any lead either expansion or compression

Make It on a Rapid Spring Winder

A simple, easily operated device for making all kinds of springs. No need for your shop or machines to be at a stand-still because of a broken or worn out spring. This machine will make exact duplicates of any spring—either compression or expansion—and do it quickly and easily. No need to tie up an expensive lathe and an expert mechanic's time to make a simple little spring. A boy can do the job quicker, better and easier on the Rapid Spring Winder. Will make any size spring simply by changing size of mandrel.

Adjustment of cam regulates pitch or "lead" of the spring. Makes springs with either right or left hand pitch.

Send today. Satisfaction guaranteed.

A time and money saver for every factory, machine shop, tool room, repair shop, garage, service station, hardware store, implement store and farm. Get one today. Money back if not satisfied within ten days.

Price Complete

With large and small handle for use on different size mandrels, and 7/16 inch mandrel and wrench, all for only $12.50. Sold through Jobber or sent postpaid to any address in United States on receipt of price. Also be sure to give name of your Jobber.

The Fostoria Screw Company

3008 Blue Print Ave. **Fostoria, Ohio**

Cut the cost of nut turning by avoiding lost motion

The

FAVORITE REVERSIBLE RATCHET WRENCH

works with a perfect mechanical movement that speeds up the nut turning, and saves money.

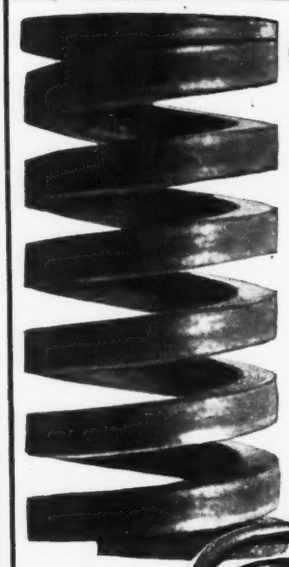
If you are still using the old-fashioned wrench send for booklet "Reduce the Cost of Nut Turning."

Greene, Tweed & Co.

Tool Department

Sole Manufacturers

109 Duane St. **New York**



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Precision Springs

For Durability and Accuracy.

For 90 Years Spring Manufacturers.

Send for our Booklet "Helical Springs"

JOHN CHATILLON & SONS

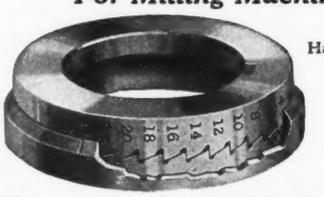
Established 1835

99 Cliff Street **New York, N. Y.**

"Wear Ever"

Adjustable Spacing Collar

For Milling Machine Arbors



Hardened Ground

SAVE SET-UP TIME

Make positive and parallel adjustments in steps of .002" without removing cutters from arbor.

Stock sizes for ¾" to 2½" arbors, sent on approval.

SCULLY-JONES & CO., TOOL DIVISION

13th and Robey Sts., CHICAGO, ILL.

Facing on the Drill Press

use the M-D Facing Head; it faces like a lathe, has a single point tool which travels radially from center outward or reverse: feeds automatically and faces diameters from 6" to 24".

Details and prices?

MUMMERT-DIXON COMPANY

HANOVER, PA.

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25	*If interested, send for circular.*
Capacity to 3/16 wire	2.50	
Capacity to 5/16 wire	5.00	

Hjorth Lathe & Tool Company

10 Tremont St. Boston, Mass.

Works: Woburn, Mass.

(Patented) Hardware Agents Wanted

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Containing the latest lists of used and rebuilt metal working machines, tools and accessories.

MACHINERY, 140-148 Lafayette St., New York

Wasted Time Costs Money!

Choose Your Used Machinery Here and Save Both

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No. 1—1 spindle Avey B.B.
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1 spindle Henry & Wright B.B.
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24-in., 32-in. and 36-in. Cincinnati Bickford upright.
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6-in.x32-in. Norton plain.
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1⅛-in., 2¼-in., and 3¼-in. Acme.
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3-in. capacity Long & Allstater Bar Iron Shear.
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24-in.x6-ft. Ohio Planer.
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36-in.x10-ft. Woodward & Powell Planer.
42-in.x36-in.x12-ft. Cincinnati Planer.
60-in.x48-in.x10-ft. Pond Planer.
72-in.x20-ft. Pond Planer.
16-in. and 24-in. Gould & Eberhardt Shaper.
16-in. and 20-in. Cincinnati Shaper.
20-in. American Shaper.
20-in. Cincinnati Shaper, traveling head.

Lathes

12-in.x5-ft. Hendey.
14-in.x6-ft. Lodge & Shipley.
16-in.x6-ft. American.
16-in.x8-ft. LeBlond.
16-in.x7-ft. LeBlond.
20-in.x8-ft. Lodge & Shipley.
20-in.x8-ft. and 12-ft. American.
24-in.x10 and 12-ft. Lodge & Shipley.
30-in.x12-ft. Lodge & Shipley.
38-in.x20-ft. Schumacher-Boye.
42-in.x20-ft. H. C. Fish.
30-in.x22-ft. Lodge & Shipley, heavy forge type.

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No. 0-½ Cincinnati plain.
Nos. 2, 3 and 4 Cincinnati plain.
Nos. 1, 2 and 3 Brown & Sharpe plain.
No. 1 Kempsmith universal.
Nos. 2 and 3 Hendey universal.
No. 2 Cincinnati universal.
No. 3-A Brown & Sharpe universal.
No. 3 and 4 Cincinnati Vertical.

General Miscellaneous

No. 2 Baker Bros. Keyseater.
3-in. and 6-in. Cutting-off Machines.
2-in. Acme Bolt Cutter.
2½-in. Acme Bolt Header.
No 2 Garvin automatic tapper.
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No. 60 Heald cylinder grinder.
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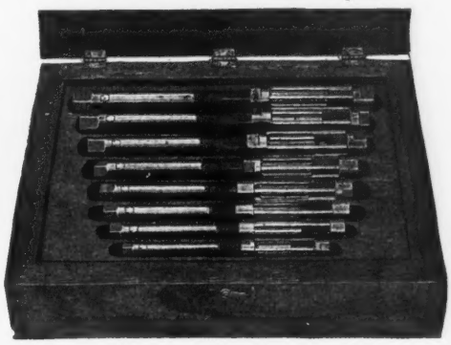

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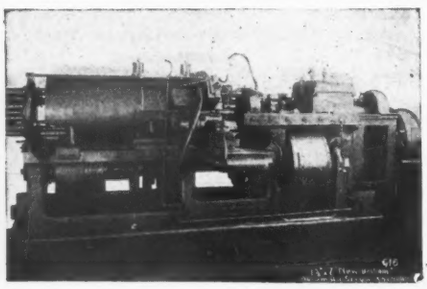

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16" Hamilton Back Geared Crank Shaper.
16" Steptoe Back Geared Crank Shaper.
20" Cincinnati Back Geared Heavy Duty Crank Shaper.
20" Rockford Back Geared Crank Shaper, single pulley drive.
20" Queen City Back Geared Crank Shaper.
24" Gould & Eberhardt Back Geared Crank Shaper.
24" Hendey Friction Geared Shaper.
24" Steptoe Heavy Duty Back Geared Crank Shaper.
24" Smith & Mills Back Geared Crank Shaper.
26"x26"x8' American Tool Works Planer, one head.
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36"x36"x10' Powell Planer, two heads.
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24"x10' American Tool Works, Q.C.
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21"x8' R. K. LeBlond Heavy Duty, Q.C.
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New 11x24" Artisan Lathe.
No. 4 Warner & Swasey Universal Turret.
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New No. 1 SP Garvin Hand Screw Machine.
No. 2 Foster Plain Head Screw Machine.
No. 2 SP Garvin Hand Screw Machine.
No. 4 Bardons & Oliver Turret Screw Machine.
No. 4 Brown & Sharpe Wire Feed Screw Machine.

Grinders and Gear Machinery

No. 2 Cincinnati Plain Grinder, late type.
6x15" Fitchburg Plain Cylindrical Grinder.
6x32" Norton Plain Cylindrical Grinder.
No. 70 Heald Internal Grinder.
No. 60 Heald Cylindrical Grinder.
No. 1 Brown & Sharpe Universal Cylinder Grinder.
No. 1 Diamond Machine Co. Universal Grinding Machine.
No. 3 Brown & Sharpe Universal Tool & Cutter Grinder.
No. 61 Fellows Gear Shaper.
No. 12 Barber-Colman Gear Hobber.
18x12" Gould & Eberhardt Automatic Gear Hobber.
No. 12 Brown & Sharpe Auto. Spur & Bevel Gear Cutters.
No. 3 Brown & Sharpe Gear Cutter.
No. 6A Cincinnati Auto. Spur Gear Cutter, cap. 72" gears.

Bolt Cutters

2" Landis Double Head Bolt Threading Machine, with lead screw.
1½" Acme Double Spindle Bolt Threading Machine.
1½" Acme Single Spindle Bolt Threading Machine.
1" Landis Single Spindle Bolt Threading Machine, with lead screw.
1" Acme Class A Single Spindle Bolt Threader.
½" Acme Single Spindle Bolt Threader.

Milling Machines

No. 3 R. K. LeBlond Universal.
No. 2 Cincinnati Universal.
No. 1½ R. K. LeBlond Universal.
No. 1½ Rockford Universal.
No. 1 Cincinnati Universal.
No. 28 Ohio (Oesterlein) Plain.
No. 22 Garvin Vertical.
New No. 21 Garvin Plain.
No. 5 Becker Vertical.
No. 2 Cincinnati Plain.
No. 3B Brown & Sharpe Plain, single pulley.
No. 3B Heavy Brown & Sharpe Plain, single pulley.
No. 3 Cincinnati Plain.
No. 4 R. K. LeBlond Plain, with vertical attachment.

Miscellaneous

50" Niles Vertical Boring Mill, two heads.
88" Open Back Multiple Punch, motor drive.
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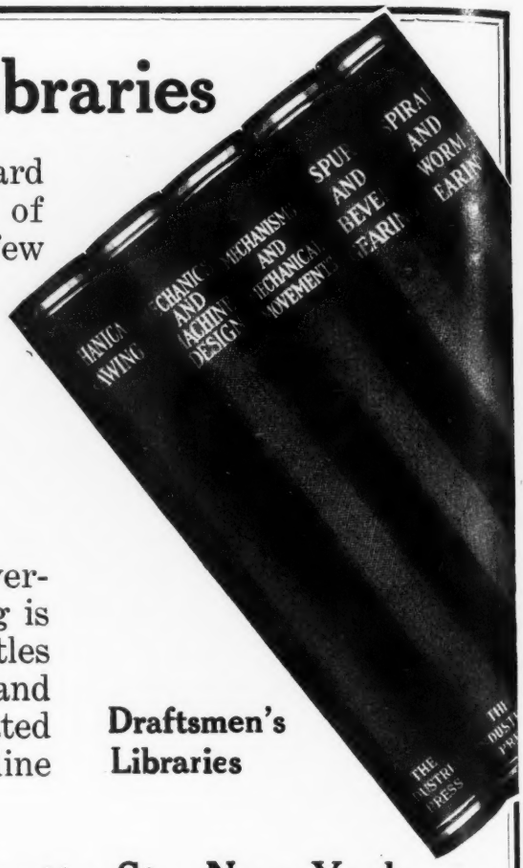

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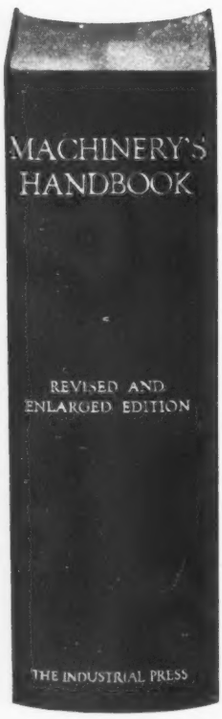

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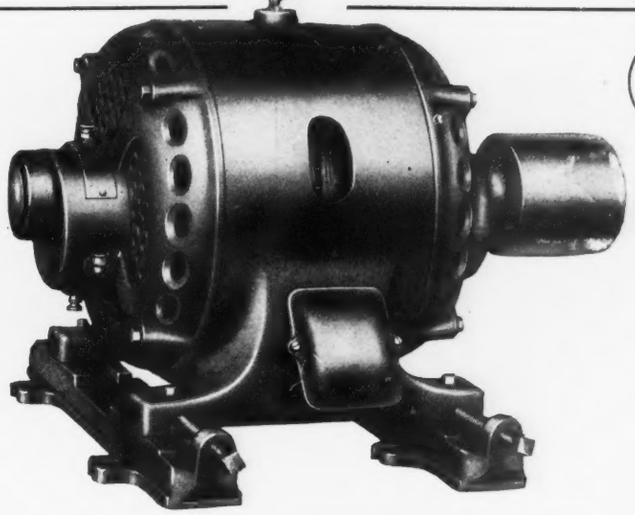

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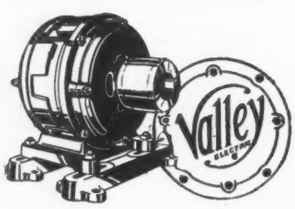

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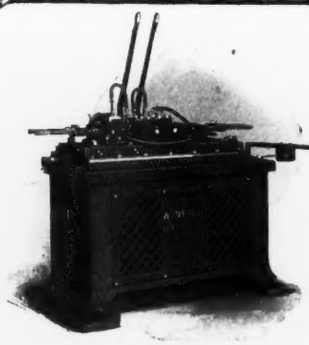

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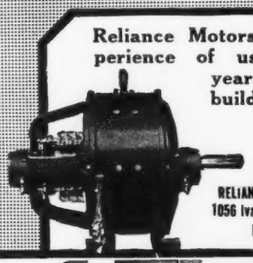

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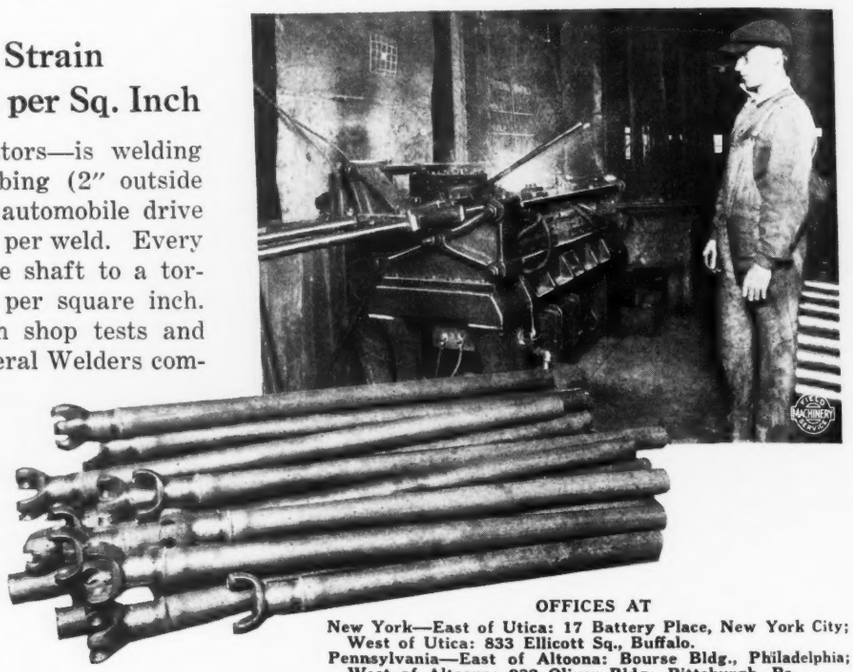

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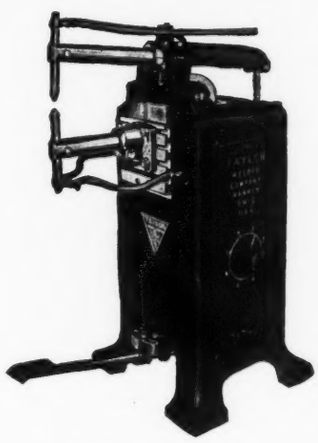

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The New Series "N" TAYLOR SPOT WELDERS

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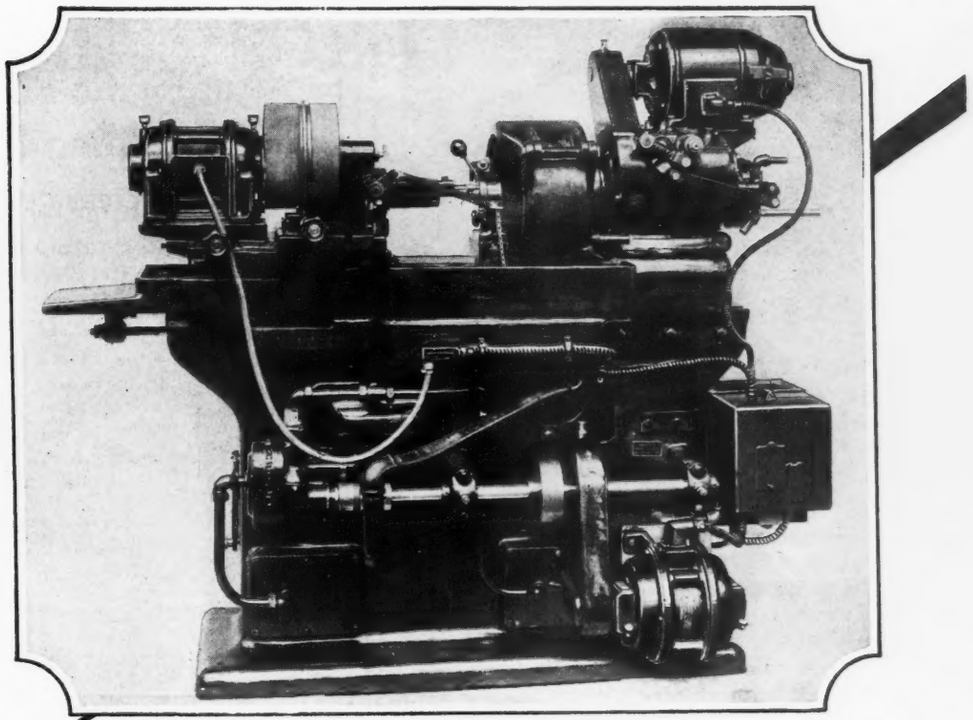

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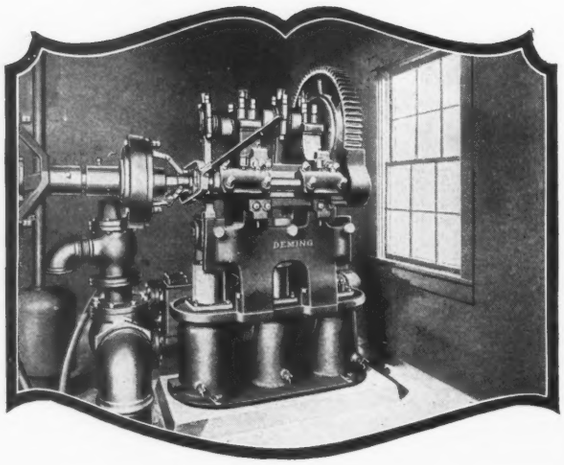

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Deming

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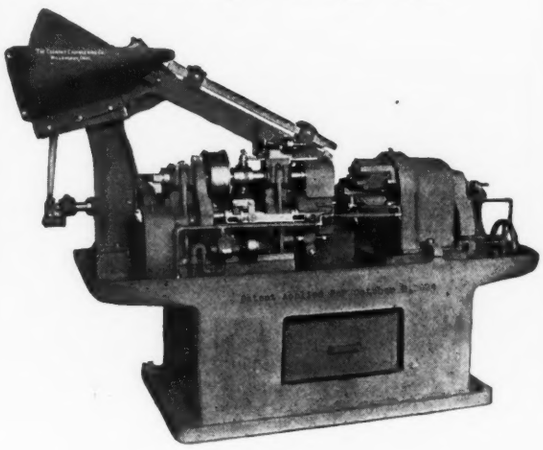

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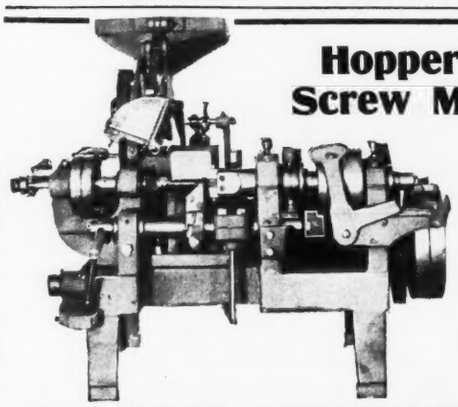

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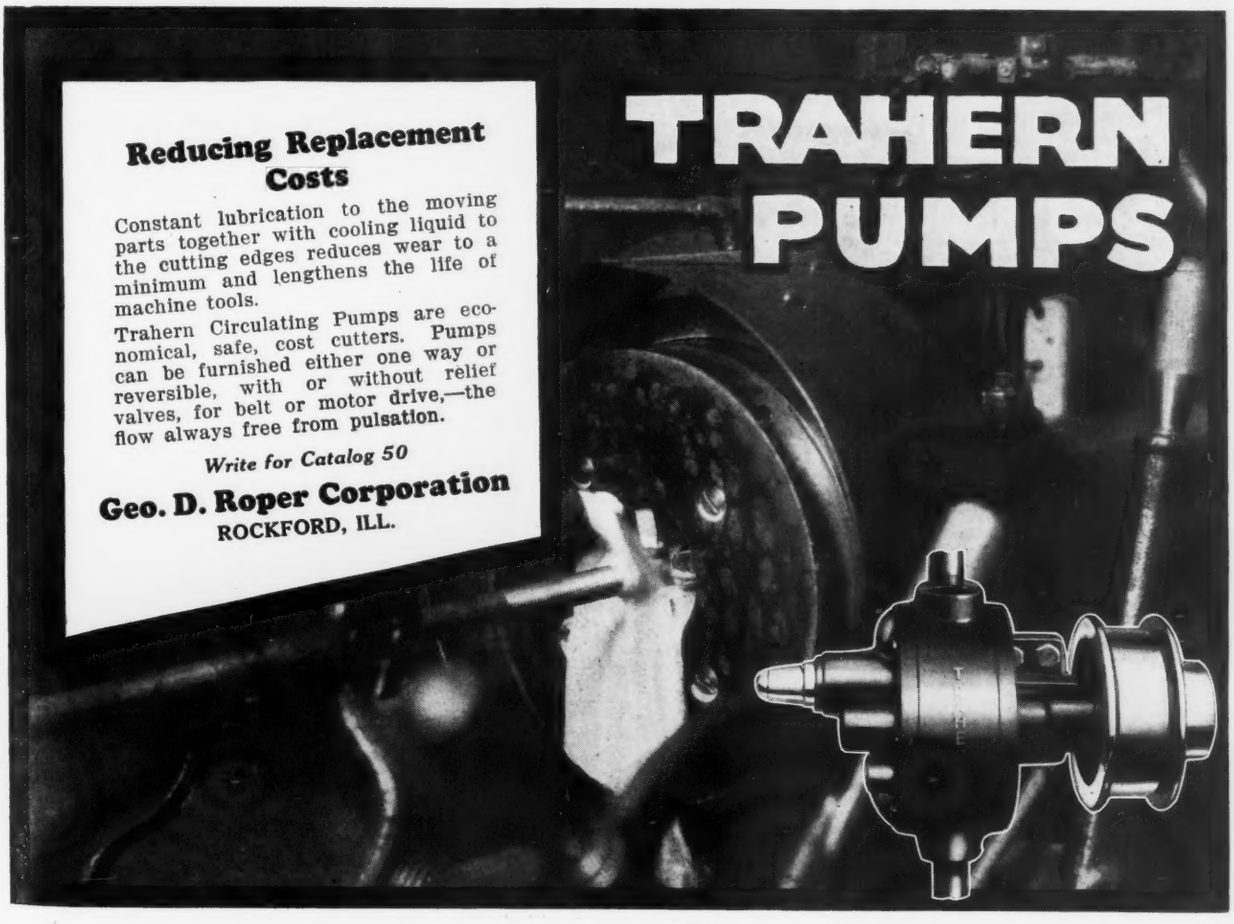

MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 301-302

ABRASIVE CLOTH AND PAPER
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, HYDRAULIC
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
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Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

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See Hoists, Air.

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Vanadium-Alloys Steel Co., Latrobe, Pa.

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Boston Scale & Mch. Co., Boston, Mass.

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Yost Mfg. Co., Meadville, Pa.

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See Presses, Arbor.

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Eastern Tube & Tool Corp., Brooklyn, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
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Western Tool & Mfg. Co., Springfield, Ohio.

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Greenfield Tap & Die Corp., Greenfield, Mass.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill Tool Co., Detroit, Mich.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass

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Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Hoyt Metal Co., St. Louis, Mo.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Gwilliam Co., Brooklyn, N. Y.
Hoover Steel Ball Co., Ann Arbor, Mich.

BARS, BORING
See Boring Bars.

BARS, PHOSPHOR BRONZE
Bunting Brass & Bronze Co., Toledo, Ohio.

BARS STEEL
Carnegie Steel Co., Pittsburgh, Pa.

BEARINGS, BABBITT
Bunting Brass & Bronze Co., Toledo, Ohio.
Franklin Die-Casting Corp., Syracuse, N. Y.
Hoyt Metal Co., St. Louis, Mo.
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Stewart Die Casting Corp., 4512 Fullerton Ave., Chicago.
Wood, T. B., Sons Co. Chambersburg, Pa.

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Ball & Roller Bearing Co., Danbury, Conn.
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Fafnir Bearing Co., New Britain, Conn.
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Marlin-Rockwell Corp., (Gurney), Jamestown, N. Y.
New Departure Mfg. Co., Bristol, Conn.
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Torrington Co., Torrington, Conn.

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Wood, T. B., Sons Co. Chambersburg, Pa.

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Timken Roller Bearing Co., Canton, O.

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Sellers & Co., Inc., Wm., Philadelphia.
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Moline Tool Co., Moline, Ill.
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Consolidated Machine Tool Corp., Rochester, N. Y.
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Sellers & Co., Inc., Wm., Philadelphia.

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Williams, J. H., Co., Buffalo, N. Y.

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Giddings & Lewis Mche. Tool Co., Fond-du-lac, Wis.
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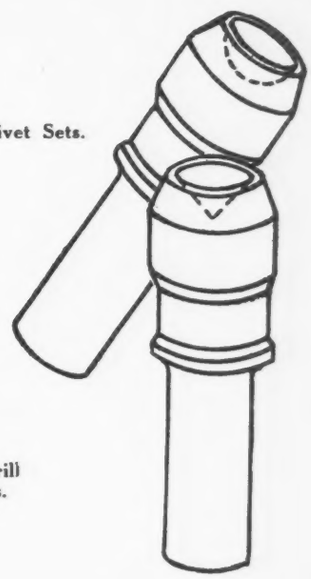

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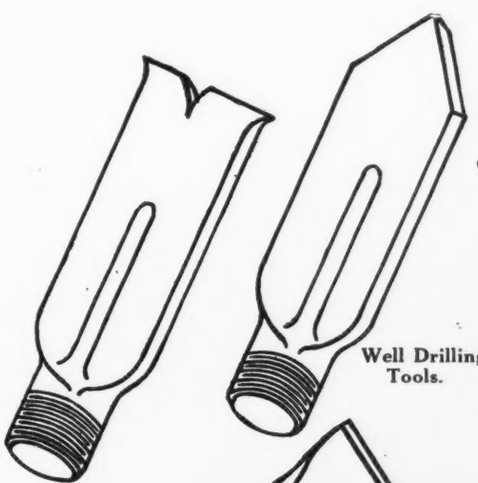

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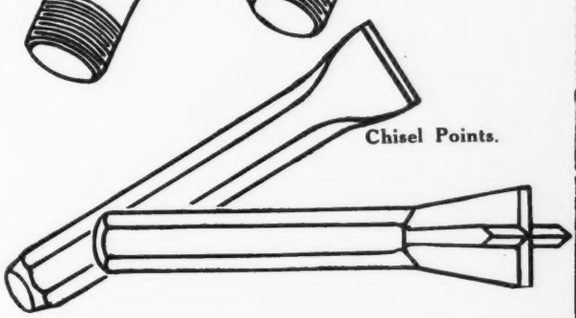

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Valley Electric Co., St. Louis, Mo.

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Franklin Die-Casting Corp., Syracuse, N. Y.
National Lead Co., 111 Broadway, New York.
Phoenix Die Casting Corp., Buffalo.
Republic Die Casting Co., Inc., 128 E. Mott St., N. Y.
Soss Mfg. Co., 776 Bergen St., Brooklyn, N. Y.
Sterling Die Casting Co., Inc., Brooklyn, N. Y.
Stewart Die Casting Corp., 4512 Fullerton Ave., Chicago.
Superior Die-Casting Co., Cleveland.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engineering Co., Chambersburg, Pa.
Cox & Sons Co., Bridgeton, N. J.
Reed-Prentice Corp., Worcester, Mass.
Sweet & Doyle Fdry. & Mch. Co., Troy, Green Island, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

CASTINGS, MALLEABLE

Link-Belt Company, Chicago.

CASTINGS, REPAIRING DEFECTIVE

Metals Coating Co. of America, Philadelphia.

CEMENT, DISC GRINDING WHEEL

Badger Tool Co., Beloit, Wis.
Besly & Co., Chas. H., 120-B N. Clinton St., Chicago.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.

CENTERING MACHINES

Consolidated Machine Tool Corp., Rochester, N. Y.
Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Mch. Co., Torrington, Conn.
Newton Machine Tool Works, Inc., Rochester, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Mch. Co., D. E., New London, Conn.

CENTERS, LATHE

Haynes Stellite Co., 30 E. 42nd St., New York.
Kell Mfg. Co., Newark, N. J.
Precision Gauge & Tool Co., Detroit, Mich.

CENTERS, PLANER AND MILLER

Cincinnati Planer Co., Cincinnati.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

CHAIN BLOCKS

See Hoists, Chain, etc.

CHAINS, POWER TRANSMISSION

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks. Sales Co., Norfolk Downs, Quincy, Mass.
Link-Belt Company, Chicago.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Conn.

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Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Ct.

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Ingersoll-Rand Co., 11 Broadway, New York.

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Ingersoll-Rand Co., 11 Broadway, New York.

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Bullard Machine Tool Co., Bridgeport, Conn.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Goss & DeLeeuw Machine Co., New Britain, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
New Britain Mch. Co., New Britain, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.

CHUCKING MACHINES, MULTIPLE SPINDLE

National-Acme Co., Cleveland, O.

CHUCKING MACHINES, SEMI-AUTOMATIC

Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
National Acme Co., Cleveland, O.
New Britain Mch. Co., New Britain, Conn.

CHUCKS, AIR OPERATED

Bardons & Oliver, Cleveland.
Frontier Chuck & Tool Co., Buffalo, N. Y.
Logansport Machine Co., 529 Market St., Logansport, Ind.

CHUCKS, COLLET OR SPLIT

Acme Co., B. C., Waltham, Mass.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Stark Tool Co., Waltham, Mass.
Wade Tool Co., Waltham, Mass.
Whitney Mfg. Co., Hartford, Conn.

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Apex Machine Co., Dayton, O.
Boker, H., & Co., Inc., 103 Duane St., New York.
Casler, Herman, Canastota, N. Y.
Cleveland Twist Drill Co., Cleveland.
Consolidatetd Machine Tool Corp., Rochester, N. Y.
Cushman Chuck Co., Hartford, Conn.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Jacobs Mfg. Co., Hartford, Conn.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones Co., 13th and Roby Sts., Chicago.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland.
Union Mfg. Co., New Britain, Conn.
Watts Bros. Tool Works, Wilmerding, Pa.
Weygandt, T. C., Co., 248 W. Broadway, N. Y. C.
Whitney Mfg. Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, FULL FLOATING

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Bullard Machine Tool Co., Bridgeport, Conn.
Cushman Chuck Co., Hartford, Conn.
Foster Machine Co., Elkhart, Ind.
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Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky Tool Corp., Meadville, Pa.
Rivett Lathe & Grinder Corp., Brighton District, Boston.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
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Whiton Mfg. Co., D. E., New London, Conn.

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McCrosky Tool Corp., Meadville, Pa.
National Tool Co., Cleveland.
Procunier, Wm. L., 18 S. Clinton St., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.

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Gardner Mch. Co., 414 E. Garden St., Beloit, Wis.
Graham Mfg. Co., Providence, R. I.

CHUCKS, TAPPING

Apex Machine Co., Dayton, O.
Barber-Colman Co., Rockford, Ill.
Buhr Machine Tool Co., Ann Arbor, Mich.
Errington Mechanical Laboratory, Broadway and John St., New York.
McCrosky Tool Corp., Meadville, Pa.
Procunier, Wm. L., 18 South Clinton St., Chicago.
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Watts Bros. Tool Works, Wilmerding, Pa.
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Oakley Chemical Co., 26 Thames St., New York.

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Edgemont Machine Co., 2700 National Ave., Dayton, Ohio.
Falls Clutch & Mchry. Co., Kent, Ohio.
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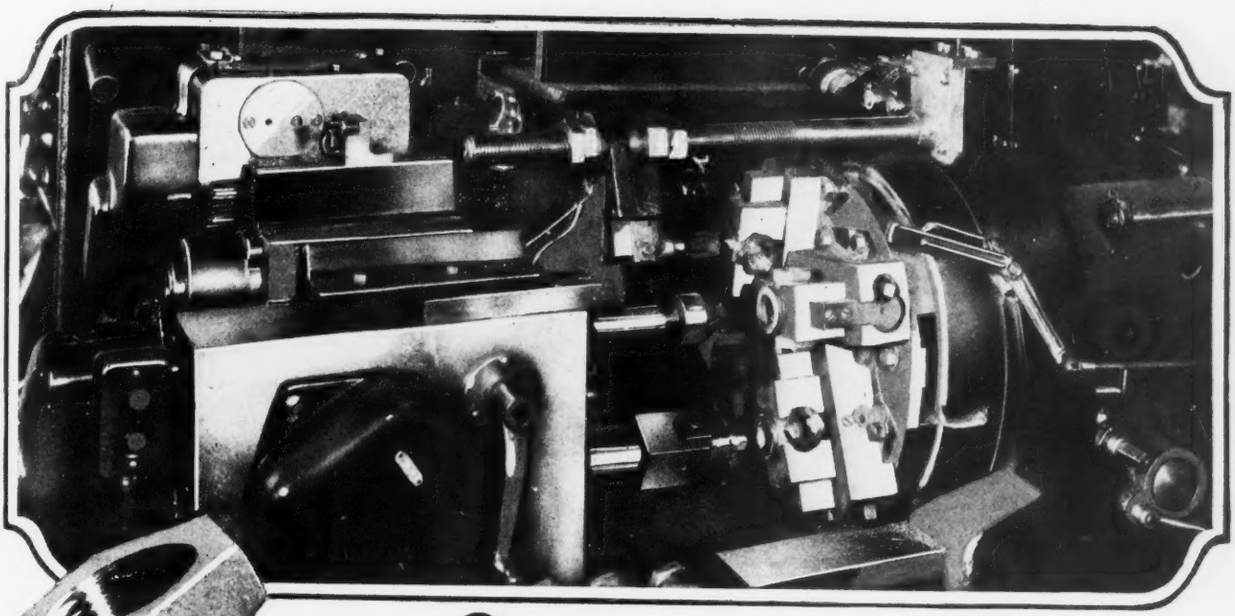

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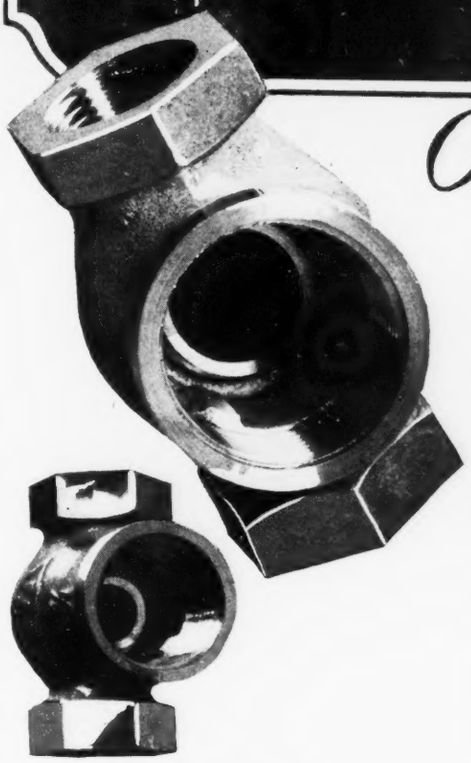

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"This machine (Goss & DeLeeuw Automatic Chucking Machine) has reduced the cost of the above operations 100%. It does more uniform and better work. After the machine is set up it is only necessary to place the piece in the chuck and remove it when finished."

Five sizes of bronze valve bodies, from ¼" to 1¼", are Centered, Rough Bored, Finish Bored and Turned, Finish Seat, and Threaded at the rate of 180 to 240 pieces per hour.

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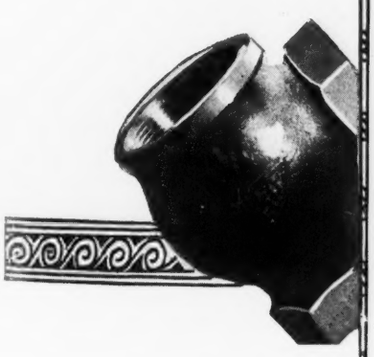
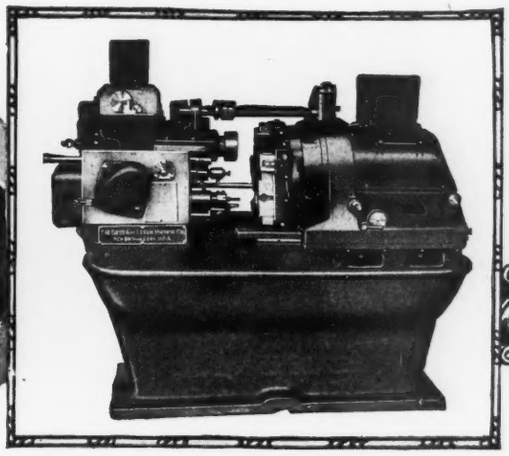
Being independently adjustable, the spindles can be set to perform each operation at top speed. Then again, all threading is controlled by positively fed lead screws, completely eliminating poor threads and breakage on small diameter taps.

Any man who is responsible for machining parts up to 6" dia. x 6¾" long should investigate this advanced type of Automatic Machine.

A catalog, explaining each mechanical feature in detail, together with production figures on representative parts, is yours for the asking. Make a point to write for a copy today!

The Goss & DE Leeuw Machine Co., NEW BRITAIN, CONN.





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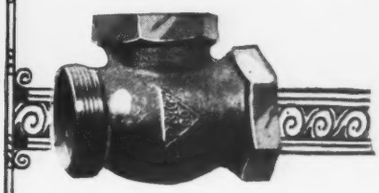

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See Sawing Machine, Circular.

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Marquette Tool & Mfg. Co., 321 West Ohio St., Chicago.

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Anderson Die Machine Co., Bridgeport, Conn.

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U. S. Tool Co., Inc., Ampere, N. J.

DIE MILLING MACHINES

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DIE SETS, STANDARD

Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
U. S. Tool Co., Inc., Ampere, N. J.

DIE SINKERS, AUTOMATIC

Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

DIE SINKING MACHINES

Cochrane-Bly Co., Rochester, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.

DIE STOCKS

See Stocks, Die and Taps and Dies.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 301-302

AJAX BULL BEARING ALLOY

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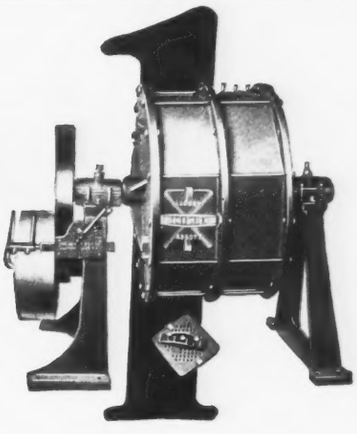

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Banner Die, Tool & Stamping Co., Columbus, O.
Bliss Co., E. W., Brooklyn, N. Y.
Columbus Die, Tool & Machine Co., Columbus, O.
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
Ferracute Machine Co., Bridgeton, N. J.
Geier Co., P. A., Cleveland.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
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Michigan Tool Co., Detroit.
Peck, Stow & Wilcox, Southington, Conn.
Pennsylvania Tool & Mfg. Co., York, Pa.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Ruthman Mchy. Co., Cincinnati, O.
Sloan & Chace, Inc., Newark, N. J.
Steel Products Engineering Co., Springfield, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
U. S. Tool Co., Inc., Ampere, N. J.
V & O Press Co., Hudson, N. Y.
Wade Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.

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Card Mfg. Co., S. W., Div. Union Twist Drill Co., Mansfield, Mass.
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Cox & Sons Co., Bridgeton, N. J.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vermont.
Landis Mch. Co., Inc., Waynesboro, Pa.
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National Acme Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg Co., Erie, Pa.
Rickert-Shafer Co., Erie, Pa.
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Winter Bros. Co., Wrentham, Mass.

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Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
H. & G. Works, Eastern Mch. Screw Corp., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vermont.
Landis Machine Co., Inc., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
National Acme Co., Cleveland, O.

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Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Carborundum Co., Niagara Falls, N. Y.
Gardner Mch. Co., 414 Gardner St., Beloit, Wis.

DIVIDING HEADS
LeBlond, R. K., Machine Tool Co., Cincinnati.
See also Milling Machines, Horizontal, Universal.

DOWEL PINS
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Universal Drafting Mch. Co., Cleveland, O.

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Abrasive Co., Bridesburg, Philadelphia.
Bridgeport Safety Emery Wheel Co., Inc., 1283 W. Broad St., Bridgeport, Conn.
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Cleveland Stone Co., Cleveland.
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Norton Co., Worcester, Mass.
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Standard Tool Co., Cleveland, O.
Western Tool & Mfg. Co., Springfield, Ohio.

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Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
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National Automatic Tool Co., Richmond, Ind.
Rockford Drilling Machine Co., Rockford, Ill.
United States Drill Head Co., 1948 W. 6th St., Cincinnati.

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Carpenter Steel Co., Reading, Pa.

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Cleveland Twist Drill Co., Cleveland.
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National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., 13th and Robey Sts., Chicago.
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Union Twist Drill Co., Athol, Mass.

DRILL SPEEDERS
Graham Mfg. Co., Providence, R. I.
Hoefer Mfg. Co., Freeport, Ill.

DRILL STANDS
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland.

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Moline Tool Co., Moline, Ill.

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Kingsbury Mfg. Co., Keene, N. H.

DRILLING MACHINES, BENCH
Ames Co., B. C. Waltham, Mass.
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Buffalo Forge Co., Buffalo, N. Y.
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Muehlmatt, Adolph, Cincinnati, Ohio.
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Rockford Drilling Machine Co., Rockford, Ill.
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Winterhoff Tool & Mch. Co., Elkhart, Ind.
Wisconsin Electric Co., Racine, Wis.

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Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
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Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
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Colburn Machine Tool Co., Rochester, N. Y.
Consolidated Machine Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
Hoefer Mfg. Tool Co., Freeport, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Leland-Gifford Co., Worcester, Mass.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Rockford Drilling Mch. Co., Rockford, Ill.
Rockford Mch. Tool Co., 2400 Kishwaukee Rd., Rockford, Ill.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.

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Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, Ohio.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Colburn Machine Tool Co., Rochester.
Consolidated Machine Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Rockford Drilling Machine Co., Rockford, Ill.
Rockford Mch. Tool Co., 2400 Kishwaukee Rd., Rockford, Ill.

DRILLING MACHINES, HORIZONTAL, DUPLEX
Buhr Machine Tool Co., Ann Arbor, Mich.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
Rockford Drilling Machine Co., Rockford, Ill.

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Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Buhr Machine Tool Co., Ann Arbor, Mich.
Foote-Burt Co., Cleveland.
Harrington Company, Philadelphia, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Pratt & Whitney Co., Hartford, Conn.
Rockford Drilling Machine Co., Rockford, Ill.
United States Drill Head Co., 1948 W. 6th St., Cincinnati.

DRILLING MACHINES, MULTIPLE SPINDLE, HORIZONTAL
Buhr Machine Tool Co., Ann Arbor, Mich.
Greenlee Bros. & Co., Rockford, Ill.
Harrington Company, Philadelphia, Pa.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
United States Drill Head Co., 1948 W. 6th St., Cincinnati.

DRILLING MACHINES, MULTIPLE SPINDLE, TURRET
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.

DRILLING MACHINES, MULTIPLE SPINDLE, VERTICAL
Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford Ill.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Buhr Machine Tool Co., Ann Arbor, Mich.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Rochester, N. Y.
Consolidated Machine Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Greenlee Bros. & Co., Rockford, Ill.
Harrington Company, Philadelphia, Pa.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland Tool Co., Moline, Ill.
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Rockford Mch. Tool Co., 2400 Kishwaukee Rd., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia.
United States Drill Head Co., 1948 W. 6th St., Cincinnati.

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Independent Pneu. Hammer Co., 600 W. Jackson Blvd., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.

DRILLING MACHINES, PORTABLE ELECTRIC
Biax Flexible Shaft Co., Inc., 136 Liberty Street, New York.
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Cincinnati Electrical Tool Co., Cincinnati.
Errington Mechanical Laboratory, Broadway and John St., New York.
Haskins Co., R. G., 3452 W. Lake St., Chicago.
Independent Pneu. Hammer Co., 600 W. Jackson Blvd., Chicago.
Neil & Smith Electric Tool Co., Cincinnati.
Stow Mfg. Co., Binghamton, N. Y.
Wisconsin Electric Co., Racine, Wis.

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American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
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Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Cincinnati Electrical Tool Co., Cincinnati.
Dreses Machine Tool Co., Cincinnati.
Fosdick Machine Tool Co., Cincinnati.
Giddings & Lewis Mchc. Tool Co., Fond-du-lac, Wis.
Morris Machine Tool Co., Cincinnati.
Mueller Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Corp., Worcester, Mass.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.
Taylor & Fenn Co., Hartford, Conn.
Western Mch. Tool Works, Holland, Mich.

DRILLING MACHINES, RAIL
Baker Bros., Inc., Toledo, O.
Colburn Machine Tool Co., Rochester.
Consolidated Machine Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
General Electric Co., Schenectady, N. Y.
Harrington Company, Philadelphia, Pa.
Moline Tool Co., Moline, Ill.
Newton Machine Tool Works, Inc., Rochester, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, SENSITIVE
Avey Drilling Mch. Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, Ohio.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Edlund Machinery Co., Inc., Cortland, N. Y.
Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
High Speed Hammer Co., Inc., Rochester, N. Y.
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Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford, Worcester, Mass.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Merit Oil Equipment Co., Cleveland, Ohio.
Muehlmatt, Adolph, Cincinnati, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rockford Drilling Machine Co., Rockford, Illinois.
Rockford Mch. Tool Co., 2400 Kishwaukee Rd., Rockford, Ill.
Royersford Fdry. & Mchc. Co., 54 Main St., Royersford, Pa.
Sibley Machine Co., 8 Tutt St., South Bend, Ind.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.
Townsend, H. P., Mfg. Co., Hartford, Conn.
United States Machine Tool Co., Cincinnati.
Winterhoff Tool & Mch. Co., Elkhart, Ind.

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Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Rochester.
Consolidated Machine Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
Harrington Company, Philadelphia, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Merit Oil Equipment Co., Cleveland, Ohio.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Rockford Drilling Machine Co., Rockford, Ill.

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Demco
Sensitive Drills

Model D—
2 Spindle Floor Type

The Drill Spindle without Vibration

MERIT OIL EQUIPMENT CO.
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Rockford Mch. Tool Co., 2400 Kishwaukee Rd., Rockford, Ill.
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Sibley Machine Co., 8 Tutt St., South Bend, Ind.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
United States Machine Tool Co., Cincinnati.

DRILLING MACHINES, WALL RADIAL
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Wickes Bros., Saginaw, Mich.

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Cleveland Twist Drill Co., Cleveland.
Cogsdill Mfg. Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Slocomb, J. T., Providence, R. I.
Standard Tool Co., Cleveland.

DRILLS, CORE
Gairing Tool Co., Inc., Detroit.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

DRILLS, RATCHET
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Greene, Tweed & Co., 109 Duane St., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.

DRILLS, SQUARE AND HEXAGON
Watts Bros. Tool Works, Wilmerding, Pa.

DRILLS, TWIST
Cleveland Twist Drill Co., Cleveland.
Colton, Arthur, Co., 2618 Jefferson Ave., E. Detroit, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Salvage Co., Detroit, Mich.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.

DRILLS, WIRE
Cogsdill Mfg. Co., Detroit, Mich.

DYNAMOS
General Electric Co., Schenectady, N. Y.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

ELEVATORS
Link-Belt Company, Chicago.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheels.

ENGINEERS, CONSULTING MECHANICAL
King, R. D., 1620 Monadnock Block, Chicago.
Manufacturers' Consulting Engineers, Syracuse, N. Y.

ENGINES, OIL AND GAS
Ingersoll-Rand Co., 11 Broadway, New York.

ENGINES, STEAM
Buffalo Forge Co., Buffalo, N. Y.
Cox & Sons Co., Bridgeton, N. J.
Ingersoll-Rand Co., 11 Broadway, New York.

ENGRAVING MACHINES
Preis & Co., Inc., H. P., Newark, N. J.

ETCHING APPARATUS, ELECTRIC
Luma Electric Equipment Company, Toledo, O.

EXPANDERS, TUBE
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Watson-Stillman Co., 192 Fulton St., New York.

EXPANSION JOINTS
Nuttall, R. D., Co., Pittsburgh, Pa.

FANS, EXHAUST, ELECTRIC VENTILATING
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

FERRO TUNGSTEN
Vanadium-Alloys Steel Co., Latrobe, Pa.

FIBRE SPECIALTIES
Wilmington Fibre Specialty Co., Wilmington, Del.

FILE AND TOOL HANDLES
Osgood Tool Co., J. L., Buffalo, N. Y.

FILES
American Swiss File & Tool Co., Elizabeth, N. J.
Simonds Saw & Steel Co., Fitchburg, Mass.

FILES, ROTARY
Strand & Co., N. A., 5001 N. Lincoln St., Chicago.

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Ames Co., B. C., Waltham, Mass.
Cochrane-Bly Co., Rochester, N. Y.
Haskins Co., R. G., 3452 W. Lake St., Chicago.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILLET, LEATHER
Graton & Knight Mfg. Co., Worcester, Mass.

FILTERS, OIL
Tolhurst Machine Works, Troy, N. Y.

FITTINGS, HYDRAULIC
Hydraulic Press Mfg. Co., Mount Gilead, Ohio.
Metalwood Mfg. Co., Detroit, Mich.
Watson-Stillman Co., 192 Fulton St., New York.

FITTINGS, STEAM
Dart, E. M., Mfg. Co., Providence, R. I.

FLUX, WELDING
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.

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American Gas Furnace Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.

FORGING MACHINES
Acme Machinery Co., Cleveland.
Ajax Mfg. Co., Cleveland.
Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Williams, White & Co., Moline, Ill.

FORGINGS, DROP
Bearings Co. of America, Lancaster, Pa.
Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Williams, J. H. & Co., Buffalo, N. Y.

FORGINGS, IRON AND STEEL
American Hollow Boring Co., Erie, Pa.
Dyson & Sons, Joseph, Cleveland.
Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.

FORGINGS, SWAGED, AUTOMOBILE, ETC.
See Swaging, Automobile Parts, etc.

FORMING AND BENDING MACHINES
Cincinnati Shaper Co., Cincinnati.
Niagara Machine & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.

FOUNDRY EQUIPMENT
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., 11 Broadway, New York.
New Britain Mch. Co., New Britain, Conn.

FURNACES, ANNEALING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago.
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

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American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Hoskins Mfg. Co., Detroit, Mich.
Leeds & Northrup Co., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.

FURNACES, HARDENING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
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General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, MELTING
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General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, TEMPERING
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Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago.
General Electric Co., Schenectady, N. Y.
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Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
New Britain Mch. Co., New Britain, Conn.

FURNITURE, SHOP
Angle Steel Stool Co., Plainwell, Mich.
New Britain Mch. Co., New Britain, Conn.
Pollard Bros. Mfg. Co., Inc., 4035 N. Tripp Ave., Chicago, Ill.
Western Tool & Mfg. Co., Springfield, O.

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Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GAGE STANDARDS
Pfauter, Herman, Works, 21 Park Row, New York.
Pratt & Whitney Co., Hartford, Conn.
Zernickow, O., Co., 21 Park Row, New York City.

GAGES, COMPARATOR
Federal Products Corp., Providence, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Scherr, Geo., Co., 143 Liberty St., New York City.

GAGES, DEPTH
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, DIAL
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Lowe, H. A., Cleveland.
Scherr, Geo., Co., 143 Liberty St., New York City.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Wallace Bros., 166 N. Wells St., Chicago.

GAGES, HEIGHT
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

GAGES, PLUG AND RING
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., 30 E. 42nd St., New York.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, RECORDING, STEAM VACUUM
Bristol Co., Waterbury, Conn.

GAGES, SNAP
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Instrument Co., Philadelphia, Pa.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Williams, J. H., & Co., Buffalo, N. Y.

GAGES, SURFACE
Brown & Sharpe Mfg. Co., Providence, R. I.
Columbus Die, Tool & Mch. Co., Columbus, O.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, TAPER
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, THREAD
Bath, John, & Co., Inc., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Mch. Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
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Taft-Peirce Mfg. Co., Woonsocket, R. I.

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Greene, Tweed & Co., 109 Duane St., New York.
Wilmington Fibre Specialty Co., Wilmington, Del.

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Bunting Brass & Bronze Co., Toledo, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

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Ganschow Co., Wm., 16 N. Morgan St., Chicago.
Graton & Knight Mfg. Co., Worcester, Mass.
Western Rawhide & Belting Co., Milwaukee, Wis.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Gleason Works, Rochester, N. Y.

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Gould & Eberhardt, Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Whiton Mch. Co., D. E., New London, Conn.

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Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Lees-Bradner Co., Cleveland.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Pfauter, Herman, Works, 21 Park Row, New York.
Scherr, Geo., Co., 143 Liberty St., New York City.
Zernickow, O., Co., 21 Park Row, New York City.

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GEAR CUTTING MACHINES, SPIRAL PINION ROUGHER
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, SPIRAL BEVEL
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, SPUR (ROTARY CUTTER)
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Gould & Eberhardt, Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
Sloan & Chace, Inc., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

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Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
Pfauter, Herman, Works, 21 Park Row, New York.
Zernickow, O., Co., 21 Park Row, New York City.

GEAR HARDENING MACHINES
Gleason Works, Rochester, N. Y.

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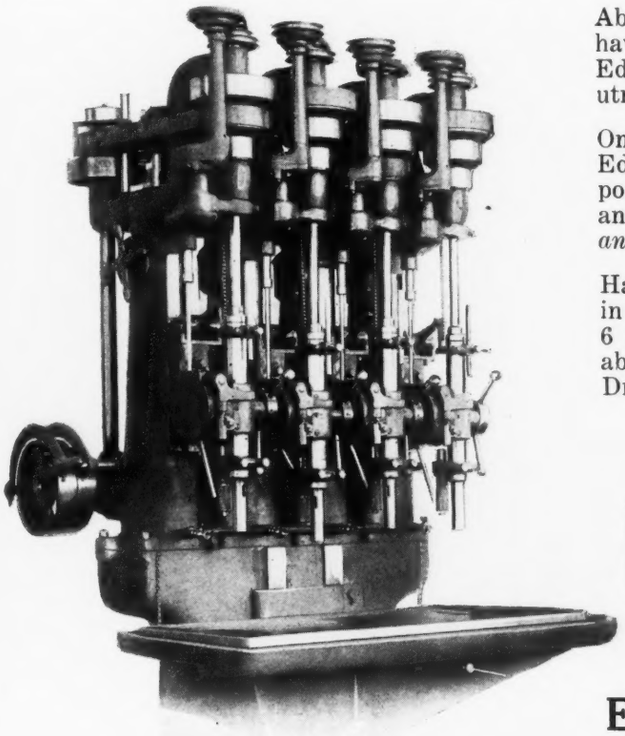
It's What's Above the Table That Counts



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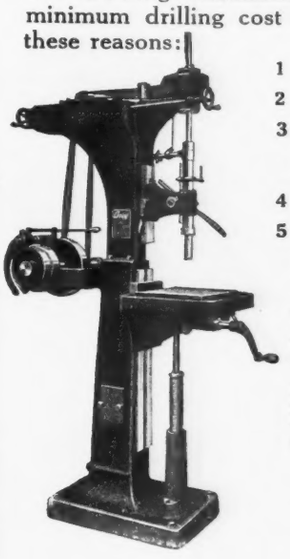

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Ferguson Gear Co., Gastonia, N. C.
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Modern Tool Co., Erie, Pa.
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Cleveland Stone Co., Cleveland.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Mitchell Engineering Co., Springfield, O.
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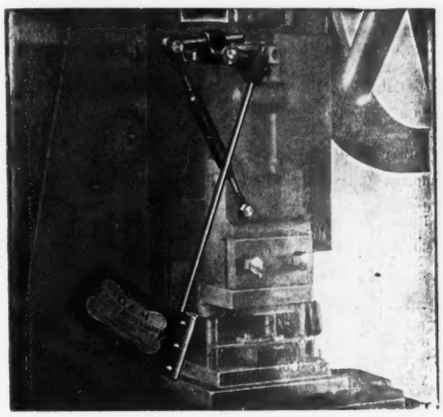

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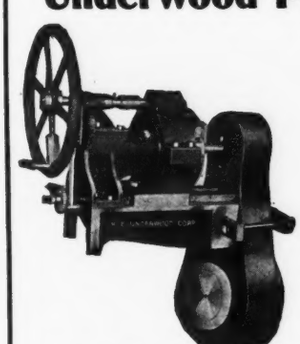

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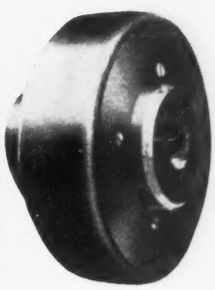

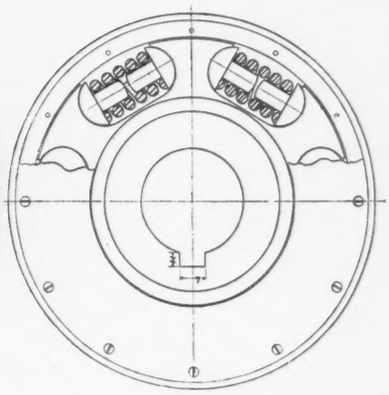

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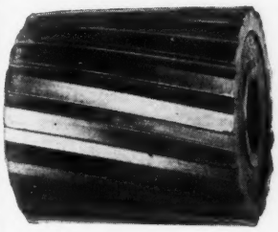

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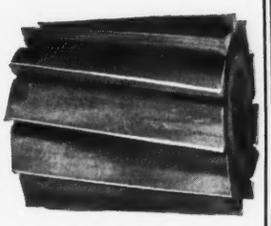

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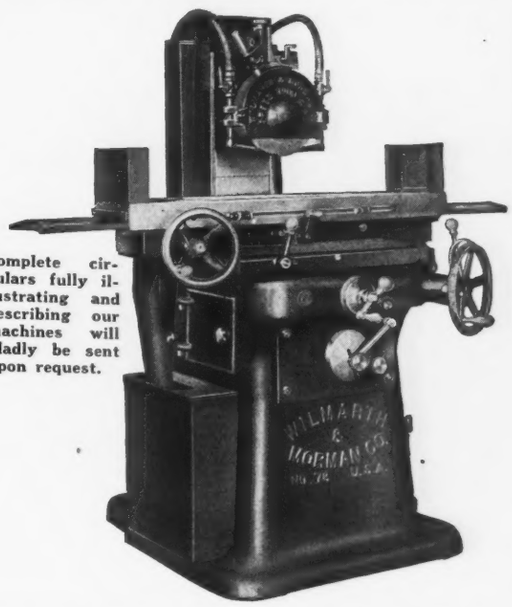

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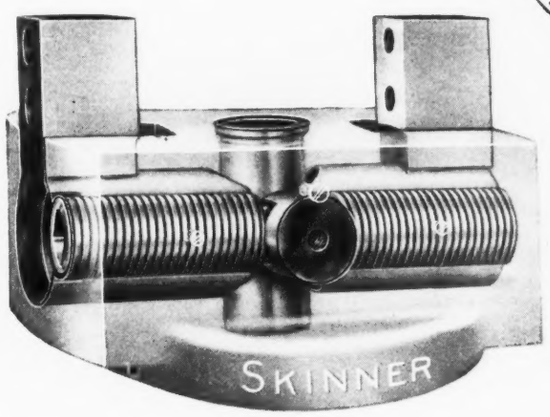
SKINNER CHUCKS FOR MODERN MACHINE TOOLS



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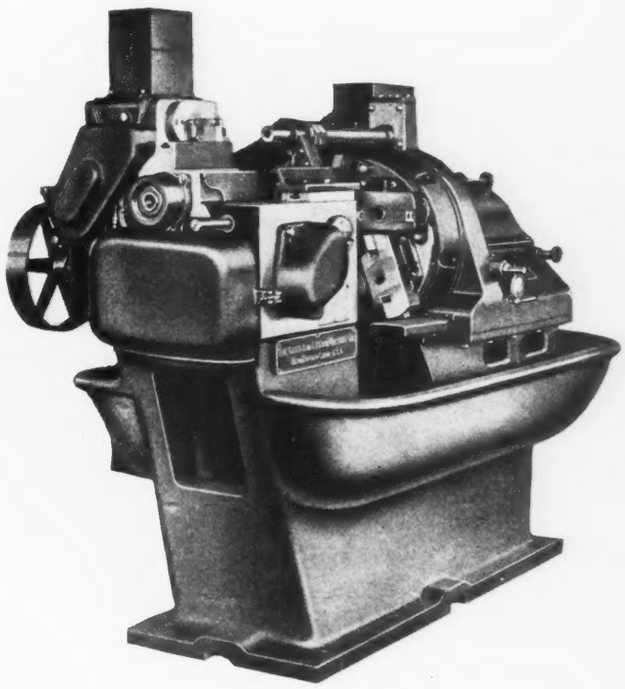

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Newton Machine Tool Works, Inc., Rochester, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 No. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

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Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Wickes Bros., Saginaw, Mich.

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Moltrup Steel Products Co., Beaver Falls, Pa.

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Taft-Peirce Mfg. Co., Woonsocket, R. I.

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Logansport Mch. Co., 529 Market St., Logansport, Ind.

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Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Bridgeport Safety Emery Wheel Co., Inc., 1283 W. Broad St., Bridgeport, Conn.
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Cincinnati Electrical Tool Co., Cincinnati.
Cleveland Armature Works, Cleveland, Ohio.
Cleveland Stone Co., Cleveland.
Diamond Mch. Co., Providence, R. I.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.
Geier Co., P. A., Cleveland.
Mitchell Engineering Co., Springfield, O.
New Britain Machine Co., New Britain, Conn.
Production Machine Co., Greenfield, Mass.
Royersford Fdry. & Mche. Co., 54 Main St., Royersford, Pa.
Stow Mfg. Co., Binghamton, N. Y.

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Atlas Press Co., Kalamazoo, Mich.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
French Oil Mill Mchy. Co., Piqua, O.
Geier Co., P. A., Cleveland.
General Mfg. Co., Detroit, Mich.
Logansport Mch. Co., 529 Market St., Logansport, Ind.
Lucas Machine Tool Co., Cleveland.
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Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
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Atlas Press Co., Kalamazoo, Mich.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
General Mfg. Co., Detroit, Mich.
Lucas Machine Tool Co., Cleveland, O.
Metalwood Mfg. Co., Detroit, Mich.
Oilgear Co., 660 Park St., Milwaukee, Wis.
Peck, Stow & Wilcox Co., Southington, Conn.
Threadwell Tool Co., Greenfield, Mass.
Toledo Machine & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., 192 Fulton St., New York.

PRESSES, DROP
See Hammers, Drop.

PRESSES, FOOT
Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Etna Machine Co., Toledo, O.
Ferracute Machine Co., Bridgeton, N. J.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Peck, Stow & Wilcox Co., Southington, Conn.
Shuster Co., F. B., New Haven, Conn.
Taylor & Fenn Co., Hartford, Conn.
Toledo Machine & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

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French Oil Mill Mchy. Co., Piqua, O.
Peck, Stow & Wilcox So., Southington, Conn.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

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American Broach & Machine Co., Ann Arbor, Mich.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Farrel Fdry. & Mch. Co., Buffalo, N. Y.
French Oil Mill Mchy Co., Piqua, O.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Metalwood Mfg. Co., Detroit, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oilgear Co., 660 Park St., Milwaukee, Wis.
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Lucas Machine Tool Co., Cleveland.
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Littell Machine Co., F. J., 4125 Ravenswood Ave., Chicago.
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Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

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Ferracute Machine Co., Bridgeton, N. J.
General Mfg. Co., Detroit, Mich.
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Cleveland Punch & Shear Works Co., Cleveland.
Federal Press Co., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
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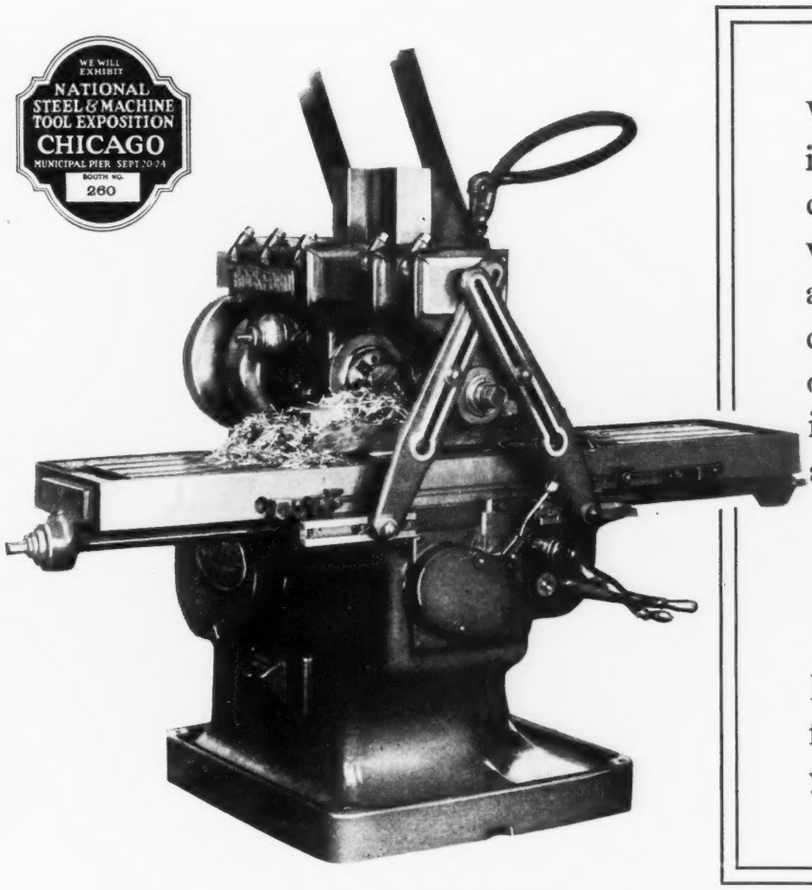

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Western Tool & Mfg. Co., Springfield, Ohio.

RACKS, TOOL

See Racks, Stock, Tool and Pattern.

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Cleveland Twist Drill Co., Cleveland.
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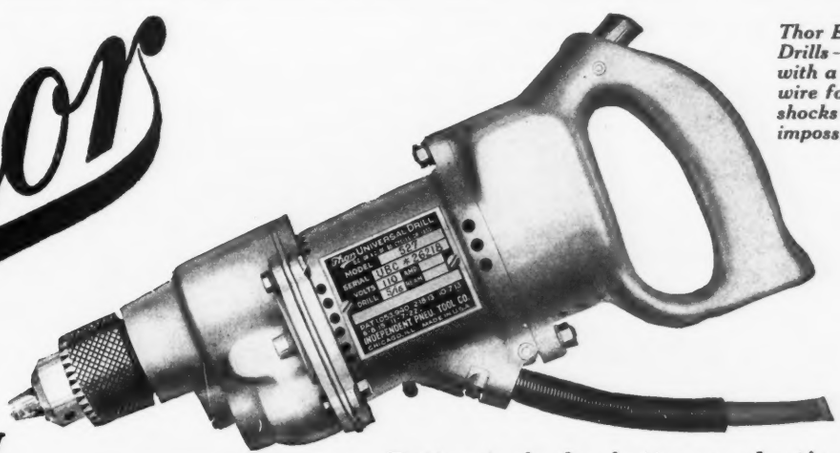

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1893

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Newton Machine Tool Works, Inc., Rochester, N. Y.

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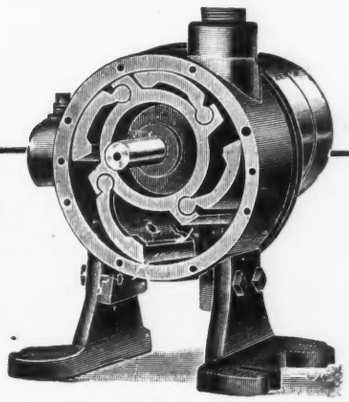

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September 7, 8, 9, 10, 1926, New Haven, Conn.

Program of Technical Sessions

Wednesday, September 8.

Sane specifications and intelligent inspection.
Individual motor drive units vs. group drive for machine tools.
Evening:—Dinner at Lawn Club with Round Table discussion.

Chairman, Carl Dietz, Pres., Bridgeport Brass Co.
Gen'l Ruggles, Ordnance Dept., U.S.A.
F. H. Penny, Ind. Eng. Dept., G. E. Co.

Thursday, September 9.

EXECUTIVES' DAY.
Machine Tools and Progress.
The district apprenticeship system.
Evening:—Symposium on "What's new in the machine tool industry?"

Chairman, C. R. Burt, Vice-Pres. and Gen'l Mgr., Pratt & Whitney Co.
Dean Dexter S. Kimball, College of Eng., Cornell.
Harold S. Falk, V. Pres. and Wks. Mgr., The Falk Corporation, Milwaukee, Wis.

Friday, September 10.

The coining press in the machine shop: some hitherto unrealized values.
Progress report of Gear Research Committee, A.S.M.E.

Chairman, W. F. Dixon, Works Mgr., Singer Mfg. Co., and Chmn. Mch. Shop Practice Div., A.S.M.E.
R. V. Crane, E. W. Bliss Co.
Earle Buckingham.

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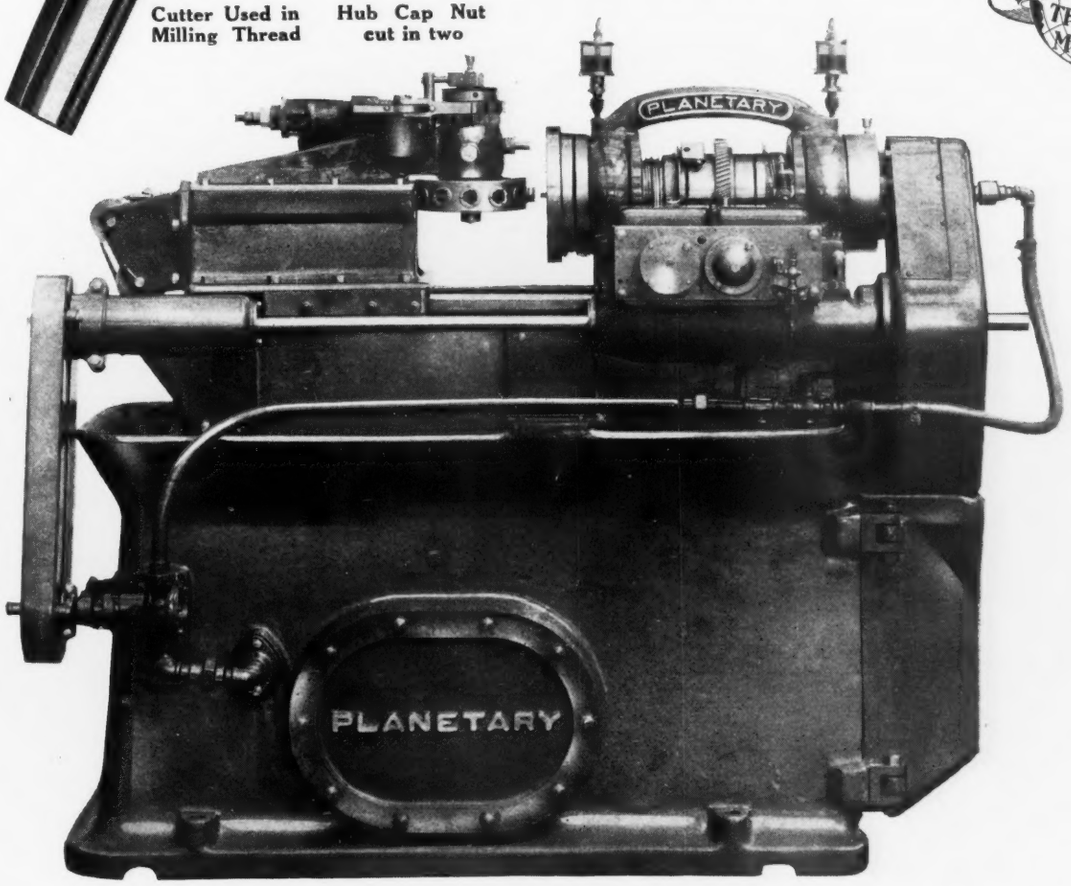

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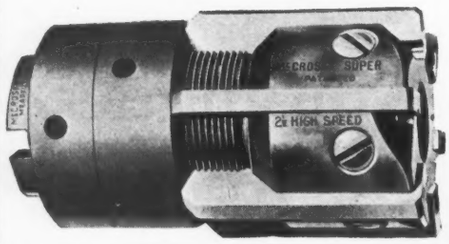

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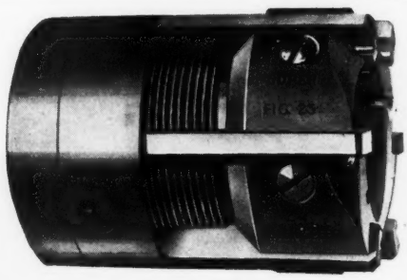
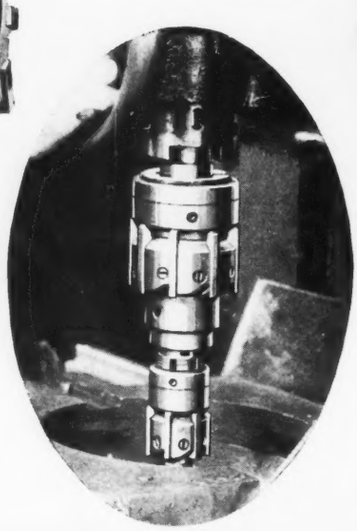
with taper hole



SUPER Shell Reamer
with large, straight hole

Lower Tool Cost
Lower Production Cost



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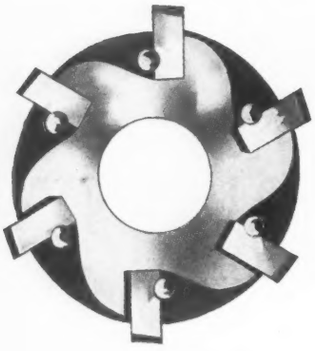

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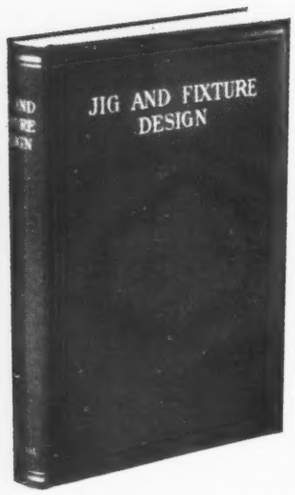

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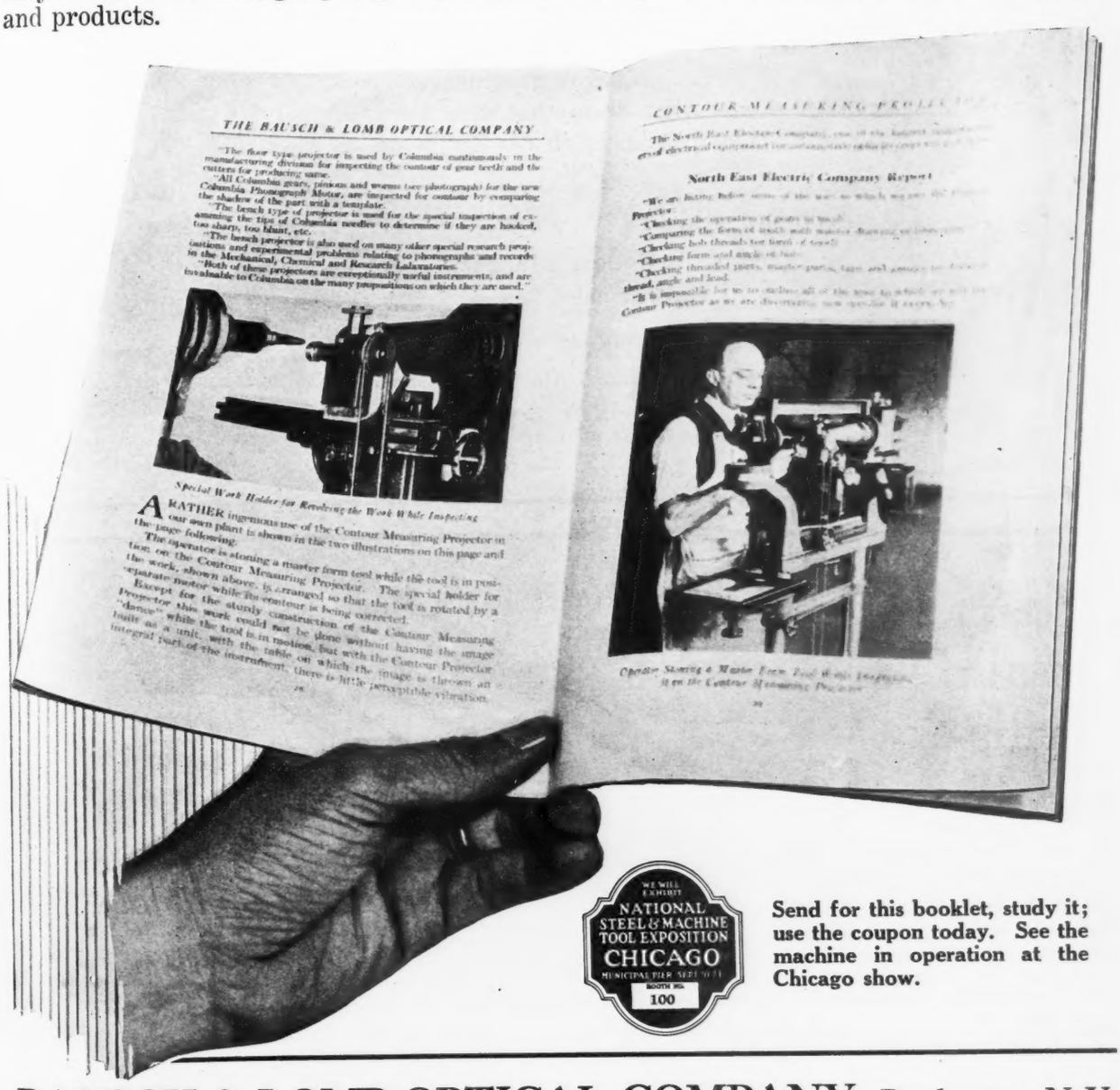
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